AMERICAN JOURNAL OF ORTHODONTICS

OFFICIAL PUBLICATION OF
THE AMERICAN ASSOCIATION OF ORTHODONTISTS,
ITS COMPONENT SOCIETIES, AND
THE AMERICAN BOARD OF ORTHODONTICS

PUBLISHED BY THE C. V. MOSBY COMPANY, ST. LOUIS 3, U. S. A.

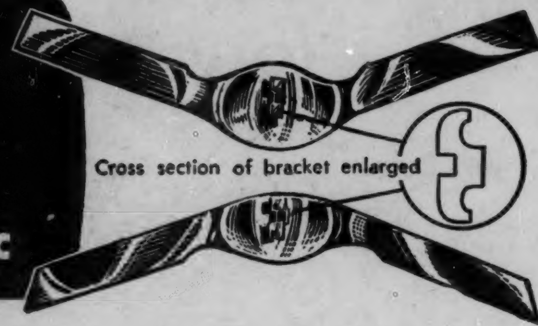
TABLE OF CONTENTS ON PAGE 2

Vol. 42 JANUARY, 1956 No. 1

NEW! *for easier adaptation and better fit—*

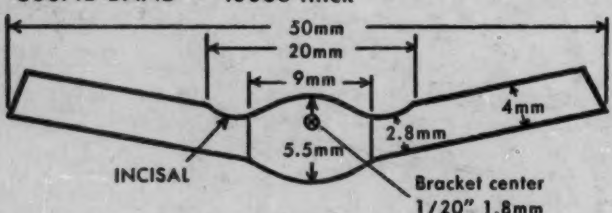
IN LESS TIME!

Whitman
CUSPID and BICUSPID BANDS FOR "EDGEWISE" TECHNIC

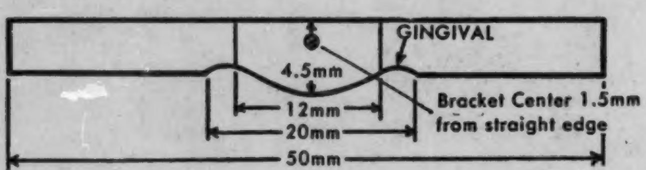


- Designed to eliminate necessity of festooning interproximal edges.
- Practically self-fitting,— contoured and designed for "Edgewise" technic.
- Shaped to bend parallel to the cut.
- Eliminates problem of "dog ears" on cuspids.

CUSPID BAND — .0035 thick



BICUSPID BAND — .0035 thick



WHITMAN BANDS ARE PRECIOUS METAL BANDS

fabricated from a highly tarnish-resistant alloy of exceptional working qualities. Hydrogen annealed for easy adaptation, the metal takes on exceptional edge strength when work hardened. Available with or without 1/20 width "Edgewise" brackets offset for easier alignment of bracket centers. Packages of 10 or 100.

now! — WILLIAMS No. 1 BAND MATERIAL
is available

WITH "EDGEWISE" BRACKETS ATTACHED

A high gold-platinum content alloy with extreme tarnish-resistance, strength and toughness, with superb working qualities.

STRAIGHT STRIPS:	1-5/8 x .004 x .150
	1-5/8 x .004 x .125
	1-7/8 x .004 x .150
CURVED CUSPID:	1-3/4 x .004 x .150

Write for Complete Catalog and Price-list of Williams Precious Metal Orthodontic Materials

ALLOYED INDUCTIVELY • UNIFORMLY SUPERIOR

WILLIAMS GOLD REFINING COMPANY INCORPORATED

2978 MAIN STREET BUFFALO 14, N. Y.

Vol. 42, No. 1, January, 1956. American Journal of Orthodontics is published monthly by The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo. Subscription rates: United States and its Possessions $10.00, Students $5.00; Canada, Latin-America, and Spain $10.50, Students $5.50; Other Countries $11.00, Students $6.00. Single copies $1.75 postpaid. Entered as Second-class matter, January 14, 1915, at the Post Office at St. Louis, Missouri, under the Act of March 3, 1879. Printed in the U. S. A.


BAKER GENUINE
JOHNSON LOCKS AND BANDS
IN PRECIOUS METAL
OR STAINLESS STEEL . . .
COIL SPRING MANDRELS & CHUCK
LOCK PLACING PLIERS
IMPROVED JOHNSON LOCK
JOHNSON VISE
Dr. Johnson restricted the manufacture of Johnson Twin Arch Locks to one company only—to assure that Johnson Locks and parts purchased in any part of the world, be interchangeable and of uniform quality. For this reason, it is advantageous to accept only Baker-Made Genuine Johnson materials.
Baker-Made Genuine Johnson Locks on pinch bands are available in stainless steel as well as precious metal for those who prefer to weld. Lock caps are also supplied in Stainless Steel.
All Baker-Made precious metal and stainless steel parts are interchangeable! For identification, Baker precious metal locks and bands are stamped B, 1, 2, 3, and 4—our steel locks and bands are stamped B.S., 1, 2, 3, and 4.
PRECIOUS METAL LOCKS AND BANDS
Per doz. $15.00
Per doz. at $100 rate $13.80
STEEL LOCKS AND BANDS
Per dozen $9.60
Per dozen in $100. orders $9.25
Inexpensive Johnson Oralium Loop Bands are available in five sizes that you'll never do without once you acquire the knack of using them.
All genuine Johnson Materials, including Instruments, Laminated Arch End Tubing, Flat Coils of Steel Arch Wire without side bends, are available.
LOCK SEATING AND REMOVING PLIERS
NO. 1
NO. 2
NO. 3
NO. 4
ANTERIOR PINCH BANDS
A
B
C
D
STAINLESS STEEL TWIN WIRE ARCH WITH .023 I. D. .035 O. D. END TUBES ORALIUM MOLAR TUBES ¼" X .036 SPRING STEEL COIL, .009 WIRE
ANTERIOR BAND FORMING PLIERS
NO. 5
NO. 1
NO. 2
NO. 3
NO. 4
LOOP MOLAR BANDS
BAKER
THE WORLD'S LARGEST WORKERS AND REFINERS OF PRECIOUS METALS
WRITE FOR A CATALOG, PRICE LIST OR PAD OF POSTPAID ORDER CARDS
BAKER & CO., INC.
EAST NEWARK, N. J. 850 Passaic Ave.
NEW YORK CITY 30 Church St.
CHICAGO 55 E. Washington Street
SAN FRANCISCO 760 Market Street

CONTENTS FOR JANUARY, 1956

American Journal of Orthodontics

Original Articles

Department of Orthodontic Abstracts and Reviews

News and Notes

Officers of Orthodontic Societies

(Editorial and Business Communications on inside back cover)

Proved superiority

ADERER'S #4 ORTHODONTIC WIRE

AVAILABLE IN ALL GAUGES

SUPERIOR ELASTIC STRENGTH

A proportional limit of 125,000 lbs. per square inch provides a maximum range of forces — minimizes need for adjustments.

SUPERIOR COLD-BENDING QUALITIES

Permits all standard adjustments safely, without rupture.

SUPERIOR ALLOYING

The absence of hot-shortness permits hot bending and is insurance against the troublesome impurities frequently responsible for breakage.

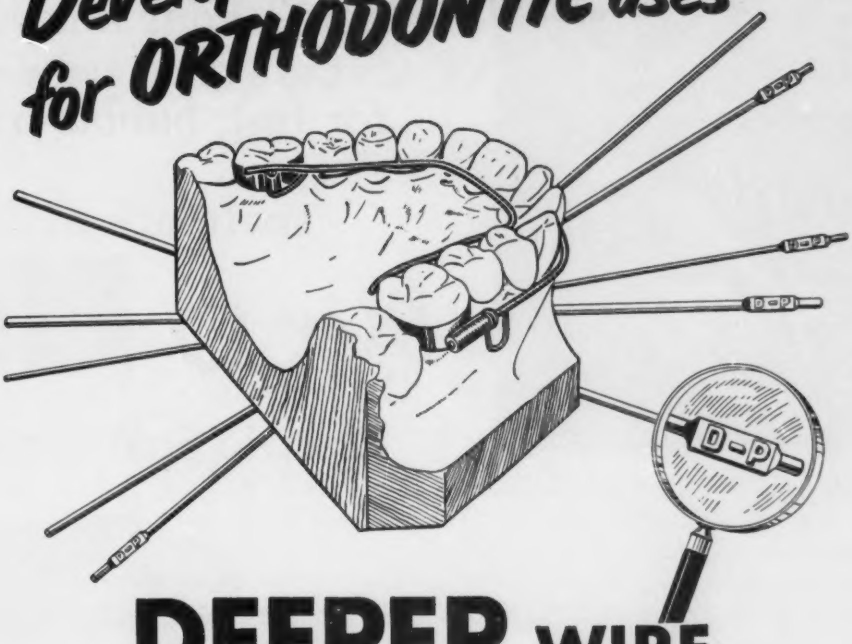
When the properties of Aderer's #4 Orthodontic Wire are studied with relation to an orthodontic appliance, they are your assurance of gentle but firm pressure for safest movement of teeth, with a minimum of adjustment during the period of treatment.

ADERER GOLDS

Julius Aderer, Inc., New York · Chicago

JULIUS ADERER INC. · 219 E. 44th ST., N. Y. · 55 E. WASHINGTON ST., CHICAGO

Developed specially for ORTHODONTIC uses



DEEPEP WIRE

OTHER DEE PRODUCTS FOR ORTHODONTICS

Dee Lock Wire

•

Deeortho Band Material

•

Deeortho Buccal Tubes

•

Deeortho Half-Round Tubes

•

Dee Solder Wire

•

Information about these products furnished at your request.

This gold-platinum alloy combines stiffness with just enough flexibility for accurate workability and with sufficient "spring back" to function properly where this quality is needed. In addition, DEEPEP wire responds readily to heat treatment.

These qualities make DEEPEP wire very satisfactory for lingual arches, auxiliary springs, stop springs and stabilizers and it is widely used for these purposes. You have to use DEEPEP wire to appreciate its exceptionally fine working properties. Once you try it, we're confident you will continue to use it. Your dealer can supply you. Insist on stamped wire to be certain you're getting genuine Deepep.

PRECIOUS METALS • DENTAL SPECIALTIES • REFINING • DEE GOLD

HANDY & HARMAN

DEE PRODUCTS GENERAL OFFICES & PLANT
1900 WEST KINZIE STREET • CHICAGO 22, ILL.
TORONTO 2B, ONTARIO, 141 JOHN ST. • LOS ANGELES 63, CALIF., 3625 MEDFORD ST.

American Journal
of
ORTHODONTICS

VOL. 42 JANUARY, 1956 No. 1

Original Articles

PRESIDENT'S ADDRESS, SOUTHERN SOCIETY OF ORTHODONTISTS

OLIN W. OWEN, D.D.S., F.I.C.D., CHARLOTTE, N. C.

IT IS, indeed, a pleasure and a privilege to welcome the members of the Southern Society of Orthodontists and guests to Charlotte for our thirty-fourth annual meeting. It is my sincere hope that your visit here will prove both profitable and enjoyable. The Program Committee and the Local Arrangements Committee have made every effort to make this an outstanding occasion. Full credit is due them.

To help us more fully appreciate our heritage as a society, I will review some of its high lights. This Society was organized in 1921 and is one of the oldest of the component societies. This was done mainly through the efforts of Dr. Oren A. Oliver and the late Dr. Clinton C. Howard. The first meeting was held in Atlanta, Georgia, with nine charter members. Of these nine charter members, four have died and, of the five living, we have three with us today, namely, Drs. Jacob A. Gorman, Thad Morrison, and Oren A. Oliver. We regret that Dr. W. B. Childs and Dr. Donald Morrison were unable to attend. Four of these five original members still maintain an active practice and are numbered among our most active and interested members. We should never depart from the principles which these men set down and, to those of us who have come into the Society in recent years, the records of these men should serve as an inspiration and challenge.

It was my privilege to join this Society in 1939. At that time there were approximately sixty-seven active members. Today this number has expanded to 159, an increase of 230 per cent in sixteen years. For the past five years

Read before the Southern Society of Orthodontists, Charlotte, North Carolina, September, 1955.

we have increased our membership on an average of approximately 10 per cent per year. At this meeting we are to consider nineteen applicants for active membership who presently hold associate membership, three applicants for active membership who have never been associate members, and fourteen applicants for associate membership. In spite of this phenomenal growth, the Southern Society of Orthodontists has remained a very friendly and harmonious group, and I am sure that each of you join me in saying, "Let's keep it that way!"

At the May, 1955, meeting of the American Association of Orthodontists, which was held in San Francisco, we were honored to have one of our members elevated to the office of president-elect, namely, Dr. A. C. Broussard of New Orleans. This is the fourth time that one of our members has held this high office.

During the past year a great effort has been made to review the duties of the Society's officers and committees. This study was spear-headed by Dr. William M. Jarrett, our president-elect, who has done an excellent job. Yesterday a "workshop" was held, composed of all officers and committees, to put into final form a brochure setting forth in detail the various duties of each committee and officer, so that each one could better know what is expected of him and, in turn, could proceed to do his duty without floundering. Naturally, the brochure cannot cover all details, nor will it tend to curb incentive or ingenuity on the part of anyone. It is our hope that, through the use of this brochure, each person will be able to do a better job in the future.

During these days of commercialism, it is most important for each of us to adhere to the principles which differentiate a profession from a business in the mind of the lay public. Surely, in a profession, as in a business, income is an important factor, but certainly income must never become the main objective in a profession. We must think always in terms of what service we are rendering instead of "What will we get?" It is an established fact that a man who prepares himself well, keeps abreast of scientific advancement, attends meetings, and participates in the programs will render the type of service which will justify proper remuneration. In addition to these facts, we have an obligation to be good citizens in our communities and enter into the civic programs. These things done, our practices and incomes will take care of themselves.

In the March, 1954, edition of the AMERICAN JOURNAL OF ORTHODONTICS, there appeared an article by Dr. C. Edward Martinek concerning the American Board of Orthodontics. I suggest that each member of this Society read this very interesting bit of information and then counsel with himself to see if it would not be worth his while to prepare for and take this Board examination, if he has not already done so. It was a great surprise to me to learn that only 25.7 per cent of our members are diplomates of the American Board of Orthodontics, which is next to the lowest rating of any of the component societies. Only two have been certified since this article was published.

Your Board of Directors met three times during the past year, first in Washington, then in San Francisco during the American Association of Ortho-

dontists' meeting last May, and finally in Charlotte on July 9 and 10 of this year, where the final plans for this meeting were consummated. Much time, many telephone conversations, and the writing of a great number of letters were required to make the meeting possible. It is our hope that it meets with your approval.

Such essayists as those who will appear before you at this meeting are hard to secure because, like you, they are busy men. They have met our challenge and will bring to us much valuable information. Each of us is deeply indebted to Dr. Adams, Dr. Dewel, and Mr. King for appearing before our group.

Recently, there has been much discussion among professional groups concerning some form of old age benefit or Social Security. In the September issue of our JOURNAL, on page 712, there was a very timely editorial by Dr. H. C. Pollock about House of Representatives Bill #10, or the Jenkins-Keogh Bill. This bill, if passed, would permit members of our profession and others exempt from Social Security to put away each year a percentage of their incomes (tax free) as an annuity or savings, the tax to be paid as the monies are used in later years. Feeling that this is an excellent plan, I recommend that this Society go on record as approving Bill H.R. 10 in preference to Social Security and to so notify the Ways and Means Committee, and that we, as individual members, write our Senators and Representatives, informing them of our action and requesting their support of this bill.

The following are additional recommendations which I would like to present for your consideration:

1. That each state organize an orthodontic study group or seminar. This has been done most successfully by the Florida group.

2. That an appropriate certificate indicating membership in this organization be designed and presented to each active member and hereafter be given to individuals as active membership is achieved.

3. That the Board of Directors collect and study the addresses of all past presidents, compile their recommendations, and put into use those suggestions that would most benefit the Society.

4. That a committee be appointed to compile a history of this Society.

In closing, I wish to thank the Board of Directors, all officers, all committee members, those who have prepared table clinics, the twelve exhibitors, and each of you for your presence here today and for your untiring efforts in making this meeting possible.

It has been a rewarding experience to have served in the official family for the past five years, three years as a director, then as president-elect, and finally as your president. To each of you, my sincere thanks for entrusting these duties to me.

1201 E. MOREHEAD ST.

THE CLINICAL APPLICATION OF THE EDGEWISE APPLIANCE IN ORTHODONTIC TREATMENT

B. F. Dewel, D.D.S.,* Evanston, Ill.

THIRTY years have passed since the edgewise mechanism was introduced to the profession.[1] During this period, the appliance at times has been the most controversial of all the mechanical devices used in orthodontics. Among its most ardent advocates have been orthodontists who have used it to the exclusion of all other appliances; yet, there are other orthodontists who have achieved excellent results without ever having applied an edgewise bracket for the correction of a dental irregularity. In between these extremes are those orthodontists who recognize definite indications for the appliance and who are fully competent to use it alone or in combination with other mechanical aids for the treatment of malocclusion of the teeth.

In its basic form, the edgewise mechanism can be described as a full-banded technique, with brackets and the auxiliary edgewise attachments applied individually to each of the teeth. It reaches its peak of efficiency in the correction of two specific types of orthodontic irregularities— (1) close-bite conditions involving an excessive curve of Spee and loss of vertical dimension and (2) space-closing procedures following extraction in malocclusions with a discrepancy between total tooth material and available supporting bone. It also provides efficient and stable anchorage when such resistance is required, and it is an effective means of moving posterior teeth distally with the aid of extraoral traction.

The principal attachment of the edgewise appliance is the bracket, with buccal tubes on the most distally placed molars. The brackets vary from the standard width of 0.050 inch to double-width and twin brackets for use on molars. In themselves, the brackets are passive. Tooth movement is accomplished by means of traction delivered to the brackets by securely attached arch wires.

In addition to the bracket, auxiliary attachments are placed on the bands to control rotations. The original design called for the use of a staple soldered mesially or distally to the bracket, depending on which way the tooth was to be rotated. This has been largely replaced by a rotating lever, one end of which is soldered close to the bracket so that the free end can be activated by arch wire pressure. After the rotation has been accomplished, the lever remains in place as an active retainer.

Read before the Southern Society of Orthodontists, Charlotte, North Carolina, Sept. 26, 1955.

*Department of Graduate Orthodontics, Northwestern University Dental School.

Tubes and brackets are designed to receive a rectangular arch wire measuring 0.022 by 0.028 inch in cross section. In actual practice, an 0.021 by 0.028 inch rectangular arch wire is used to reduce the friction of the wire within the bracket. In order to eliminate undue stress on teeth and alveolar bone, the rectangular arch ordinarily is preceded in the initial stages of treatment by smaller, round steel leveling wires.

The first to be placed is 0.016 inch in diameter. It is followed, usually in sequence, by an 0.018 inch, an 0.020 inch, and finally an 0.022 inch round arch wire. These preliminary round wires are termed *leveling arches* because their purpose is to bring all the brackets into an even alignment. In this manner, the teeth are prepared for the application of the larger rectangular arch wire. The light, round wires are gentle, flexible, and resilient; the heavier, rectangular wire is relatively rigid and unyielding. Greater regard for tissue tolerance is shown by reducing the size of the arch wires for the preliminary movement of teeth.

Any discussion of treatment procedures must, of necessity, be based on a consideration of anchorage, for the efficiency of every appliance depends on its ability to establish effective and stable areas of resistance. In itself, the rectangular wire provides the greatest possible "stationary" anchorage. The edgewise appliance, in addition, utilizes units of teeth rather than single teeth for anchorage purposes. These anchorage units are not limited to first molars; they consist of several posterior teeth, including second molars, when possible, and all the premolars in nonextraction cases. Particular emphasis is placed on anchorage stability in the mandibular arch, for it is in this arch that the limitations of orthodontic treatment are most challenging and most frequently encountered.

Anchorage effectiveness is further increased by placing tip-back bends in the posterior sections of the arch wire. This is based on the concept that the best anchorage is secured when anchor units are established with a moderate distal inclination. Obviously, if mandibular posterior teeth have tipped forward, they cannot provide as much resistance as they could if they were tipped backward. In placing tip-back bends, additional assistance must be secured by extraoral traction to cause the crowns to tip distally rather than the roots to move mesially. Either occipital or cervical anchorage may be used to assist in the distal movement of these posterior teeth.

Another procedure for increasing the efficiency of the edgewise arch involves the use of vertical loops to open or close spaces, depending on the correction being undertaken. Pull-coil springs and push-coil springs are used for individual tooth movement. These may be placed around the arch wire, or they may be ligated from molar tubes to cuspid or premolar staples. Stop spurs are soldered mesially to the molar tubes unless forward movement of the posterior teeth is desired. Hooks for intermaxillary elastics may be soldered to the arch wire, or vertical loops to serve the same purpose may be adapted directly into the arch wire.

Technical requirements for the edgewise appliance are not simple; yet, once mastered, the mechanism seems less complicated than many of the others currently in use. It is a precision appliance, and certain fundamental principles cannot be ignored. There is, for example, no leeway in bracket position—a bracket cannot be correctly placed in the middle third of three mandibular incisors and farther incisally on the remaining incisor without depressing the tooth with the incorrectly centered bracket. Brackets are lined up by arch wires. If the brackets have been positioned properly it follows that the teeth will also be brought into an even alignment.

This principle is utilized to advantage elsewhere in the arch. Brackets are placed closer to the incisal edge on cuspids and more to the gingival border on premolars. This tends to depress the cuspids and elevate the premolars, a desirable form of treatment that is particularly effective in the correction of an excessive curve of Spee.

CORRECTION OF AN EXCESSIVE CURVE OF SPEE

As an introduction to the technical application of the edgewise appliance, the various stages in the correction of a specific case are illustrated (Fig. 1). In this first patient, active treatment had been preceded by a program of serial extraction because of a marked discrepancy between total tooth material and available arch length.[2, 3] This had required a three-year period of supervision, during which the preliminary extraction of the deciduous cuspids, the deciduous first molars, and the four first premolars had been accomplished.[4, 5] Active treatment was delayed until the subsequent eruption of the second premolars and mandibular permanent cuspids.[6, 7]

The original appliance assembly consisted of bands on all teeth except the unerupted second molars and the partly erupted maxillary cuspids. The patient presented a close-bite and an excessive curve of Spee. The reciprocal action of the edgewise appliance for this correction is illustrated in the mandibular arch. For demonstration purposes, the initial 0.016 inch round steel wire was inserted only in the tubes and brackets on the first molars and second premolars. Since the mandibular teeth are not all in the same horizontal plane, this arrangement causes the anterior portion of the wire to rest several millimeters to the gingival of the brackets on the six anterior teeth. It is apparent that raising the wire for insertion into these brackets will act to depress the incisors and cuspids.

For further demonstration of the reciprocal action of the edgewise arch wire, it was then placed only in the incisor brackets and the molar tubes. In this position the wire passes occlusally to the second premolar brackets. Inserting the arch in these brackets will act to elevate the second premolars.

The next two photographs in Fig. 1 show the complete insertion of the mandibular arch wire in all the brackets. As the wire extends mesially from the molar tubes, it first dips gingivally to engage the second premolar brackets and then rises for insertion in the anterior brackets. The resulting action is

that of intrusion of incisors and elevation of the second premolars. Very likely, the cuspids and first molars were also being depressed in this stage. The pressure applied to the teeth in the beginning is gentle, since the first wire to be used in gaining bracket alignment is but a light 0.016 inch round steel arch which exerts but slight pressure. Tension was increased at ten-day

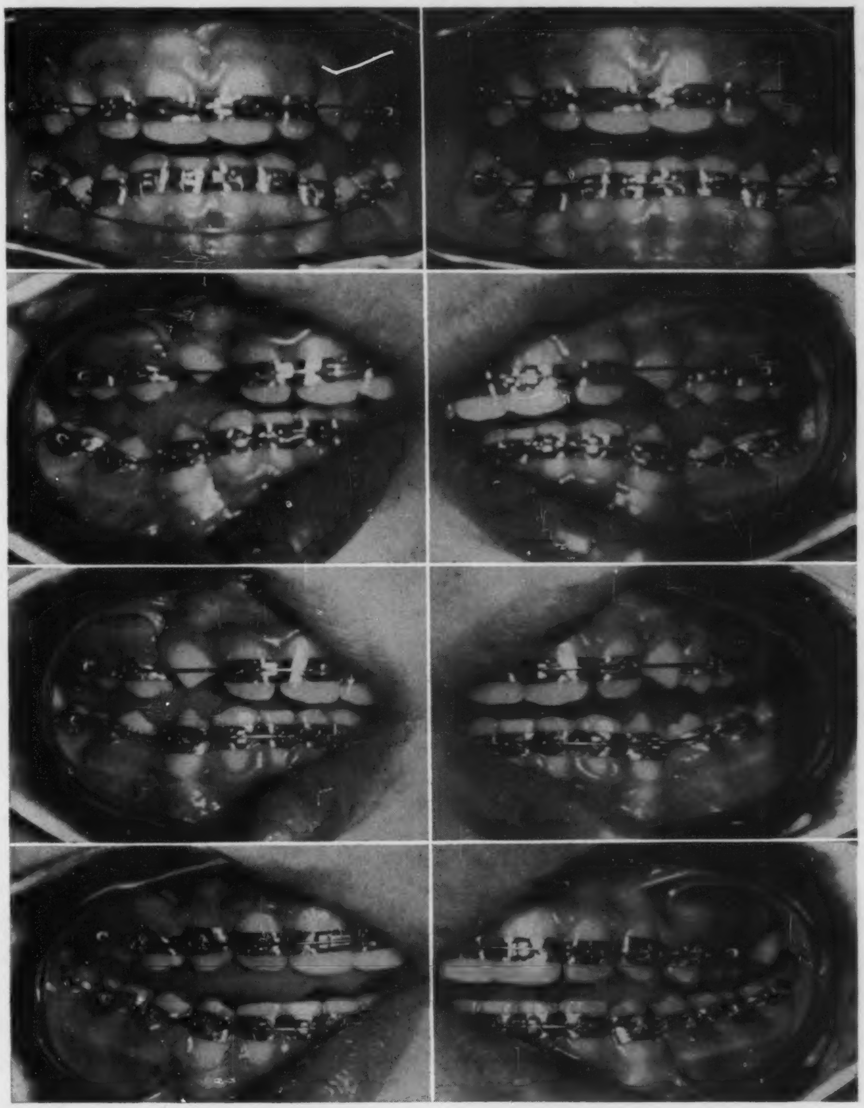


Fig. 1.—Top photographs illustrate reciprocal action of the edgewise arch wire for the correction of an excessive curve of Spee. Remaining photographs show subsequent stages in treatment. Also shown is the proper location of bands at different levels on certain teeth to aid in the close-bite correction.

intervals with new 0.018 inch and 0.020 inch arch wires, and finally with an 0.022 inch round wire, until the excessive curve of Spee had been reduced.

The next two illustrations show the resulting improvement in the mandibular occlusal plane. In order to increase the efficiency of the appliance, a

reverse curve of Spee was adapted into the 0.022 inch arch wire to cause further eruption of the premolars and intrusion of the anterior teeth. These illustrations also show that the now fully erupted mandibular second molars are elevated somewhat above the first molars. Comprehensive treatment requires correction of this irregularity if normal alignment is to be attained throughout the arch.

The final illustrations in Fig. 1 show the appliance in one of the later treatment stages. The mandibular second molars now carry bands with buccal tubes. It was not necessary to replace the first molar tubes with brackets; instead, the new arch wires were threaded through the tubes on both first and second molars.[8] This can be done easily with the small 0.016 inch steel wire, followed at intervals with the larger round wires until all the teeth are leveled off.

Fig. 1 also illustrates proper bracket positioning as a further aid in correcting the curve of Spee in the mandibular arch; the cuspid brackets are at a higher level than those of the second premolars. This precaution leads to improved function in the cuspid areas. Placing the cuspid brackets in the middle third of the teeth would have elevated the cuspids far enough to cause occlusal interference with their maxillary opponents.

Similar attention was paid to maxillary cuspid and premolar bracket position, again to avoid occlusal interference from elongated cuspids. The photographs also show proper positioning of the brackets on the maxillary lateral and central incisors; lateral incisor brackets are placed closer to the incisal edge so that, for esthetic reasons, these teeth will appear somewhat shorter than the central incisors. It is this attention to detail that leads to resuls that are functionally stable and esthetically acceptable.

TISSUE-BEARING ANCHORAGE WITH ACRYLIC PLATE

Certain preliminary tooth movements occasionally are indicated before complete orthodontic treatment is undertaken. Fig. 2 illustrates a blocked-out maxillary right cuspid which is located directly above the lateral incisor. Any attempt to move the cuspid distally with one of the standard orthodontic appliances will result in loss of anchorage if teeth alone are the source of resistance. One of the most effective supplementary devices for individual tooth movement is the maxillary acrylic plate.[9] It is designed to take advantage of tissue-bearing anchorage during the prolonged period required to move the cuspids distally.

Of particular interest in this series is the distance which the right cuspid must travel to come into contact with the second premolar. This was the indicated procedure in this Class I malocclusion; prior to treatment, loss of cuspid space had permitted the maxillary molars and premolars to drift mesially until they were in a Class II relation with their mandibular opponents. Any further mesial movement of the maxillary posterior teeth was to be avoided if at all possible.

The area covered by the plate is similar to the usual retainer. Active treatment wires extend labially from the acrylic at the distal of the lateral incisors. They then rise gingivally to rest as recurved free-end springs on the mesial surfaces of the cuspids. Passive retaining wires restrain mesial move-

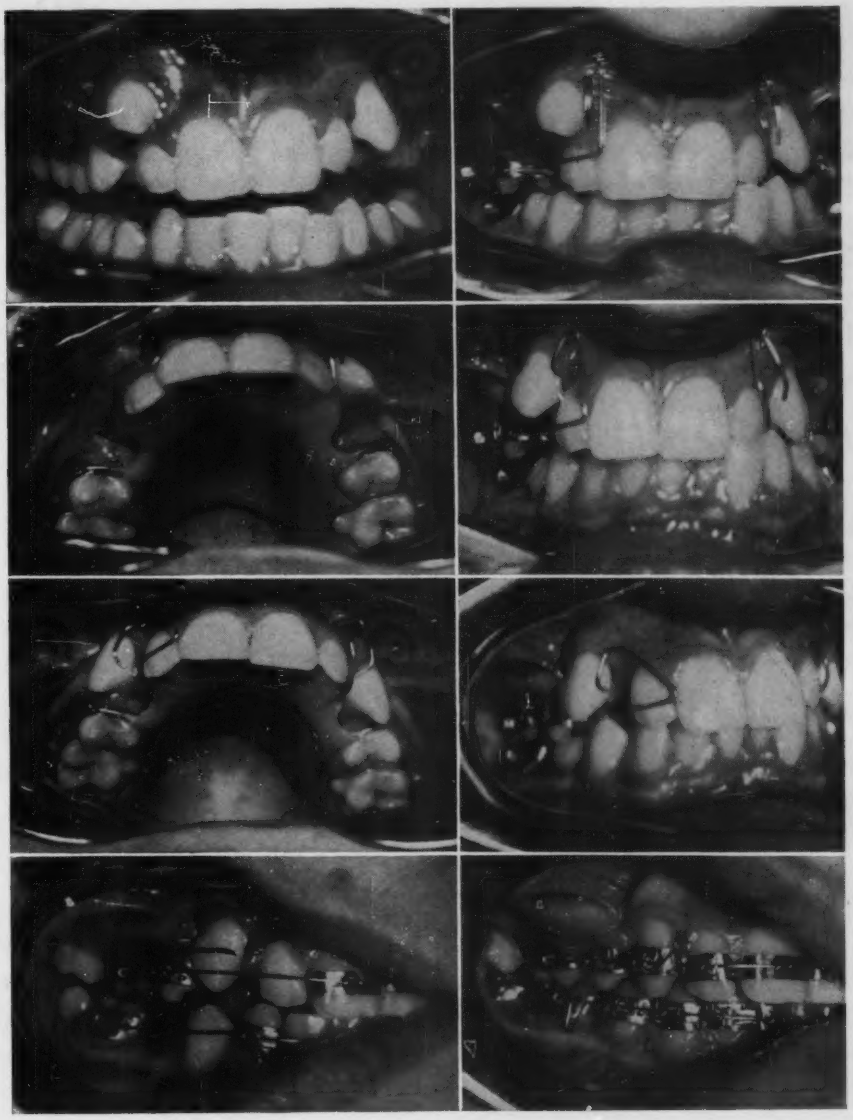


Fig. 2.—Preliminary movement of teeth with an acrylic plate relieves the molars of excessive anchorage responsibilities. Full edgewise treatment completed the correction with accurate bracket control over each individual tooth.

ment of the second premolars, and holding wires extend distally around the molars to act as clasps on the gingival surfaces of the buccal tubes.

Subsequent illustrations in Fig. 2 show the change in cuspid position during the following five and one-half months. The cuspid springs were activated at ten-day intervals, and the patient reported no discomfort whatever from

the spring pressure. During this period the maxillary posterior teeth were free from all anchorage responsibilities, and they retained stable positions when related to the undisturbed mandibular teeth.

An additional complication was the congenital absence of the mandibular second premolars. The first stage in edgewise treatment followed the removal of the retained second deciduous molars. These extractions had been delayed until the maxillary cuspids had been moved distally so that edgewise therapy could be applied simultaneously in both arches. Auxiliary spring pressure was used to move the maxillary cuspids farther to the lingual. Mesial movement of the mandibular molars was accomplished by Class II intermaxillary elastics and by the use of pull-coil springs from molars to cuspids.

The final photograph in this series illustrates marked improvement in cuspid inclination and position following further correction with a full edgewise appliance. It also shows a vertical loop spring to complete space closure in the mandibular arch. This photograph was secured after the mandibular second molars had been banded; in the early stages they had been permitted to tip mesially as they followed the first molars forward.

When second molars are included in the original appliance assembly, they increase the resistance of the first molars to mesial movement. This means an added load on anterior anchorage. Second molars should be permitted to drift mesially in these missing second premolar cases.[10] First molars thus can be moved more easily, and it is not difficult to correct the mesial inclinations of the second molars after the premolar spaces have been closed. Once again, the maxillary arch does not prove as difficult to treat as the mandibular arch; maxillary second molars move forward with much less mesial tipping than do mandibular second molars.

SELECTION AND SEQUENCE OF TEETH TO BE BANDED

Fig. 3 illustrates an extreme Class I malocclusion in which virtually every tooth has been displaced labially, buccally, or lingually from its normal position. The arches are narrow and the right first permanent molars present a cross-bite relation. All four lateral incisors are locked lingually, and the central incisors and cuspids are displaced to the labial. The case is hopeless if extraction is not made a part of treatment.

The edgewise appliance provides the secure attachment to individual teeth that is so important for success in extraction cases. However, it is not necessary, and perhaps it is even undesirable, to band every tooth in the beginning in conditions such as this. Following extraction, edgewise bands were placed only on the first molars, the central incisors, and the mandibular cuspids. Early treatment procedures were centered on correction of the cross-bite relation and in repositioning the cuspids distally, the lateral incisors labially, and the central incisors lingually.

The cross-bite was corrected with crisscross elastics and the lateral incisors were moved labially with simple wire ligatures. The mandibular cuspids were moved distally with pull-coil springs, and the maxillary cuspids were moved distally by wire springs extending labially from a maxillary acrylic plate.

After this preliminary correction had been accomplished, edgewise bands were placed on the four lateral incisors and on the mandibular second premolars. The usual sequence of small round steel arch wires were placed for further correction of the labial inclination of the maxillary central incisors and the lingual positions of the mandibular second premolars. No attempt

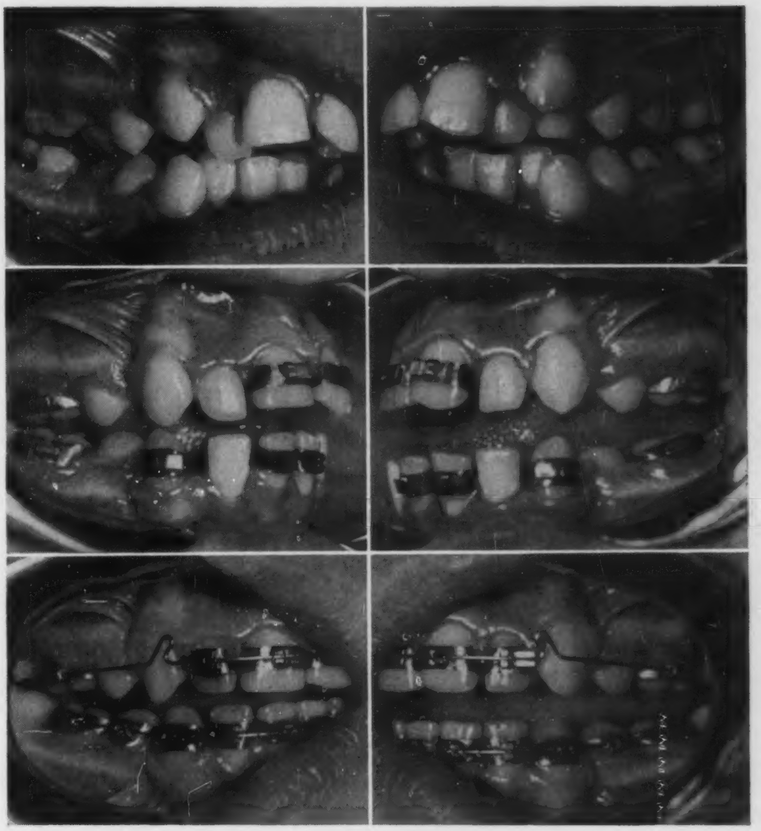


Fig. 3.—Stages in the treatment of a severe Class I irregularity requiring extraction of the four first premolars. Center photographs also illustrate inactive rotating levers. The lower right photograph shows an activated rotating lever on the maxillary left lateral incisor.

was made to make the arch wires conform to the irregularity; each wire, instead, was adapted to form an ideal arch. Since the 0.016 inch wire is flexible and resilient, there is no difficulty in ligating it into brackets on these irregular teeth. Further improvement in tooth position followed the insertion of each of the succeeding larger-gauge round steel arch wires.

The final illustrations in Fig. 3 show the 0.022 inch steel arch wires in place, with loops for light Class II elastics adapted into the maxillary arch.

Marked improvement can be seen in the inclination of the central incisors, in occlusal relations, and in general arch form in the maxillary incisor and mandibular second premolar areas. All teeth are well located over basal bone. Further correction of the remaining rotations and inclinations is required in the mandibular arch, and bands are now indicated to restore normal axial inclinations of the elongated maxillary cuspids. It probably will not be necessary to band the maxillary second premolars.

The center illustrations in Fig. 3 show good views of rotating levers on the mandibular cuspids and on the maxillary central incisors. Ordinarily, these are difficult to pick up photographically. One end of each lever is soldered to the band close to the bracket. When activated, the free end extends labially to press against the arch wire. In these center illustrations the levers are inactive; they lie flat against the bands.

The lower right photograph shows an active rotating lever on the maxillary left lateral incisor. This lever projects labially so that it is in contact with the arch wire. It has been activated by ligating the wire into the bracket. The ligature pulls labially on the bracket and the arch wire pushes lingually on the lever. This results in the rotation of the mesial side of the lateral incisor labially and the distal side lingually. These levers are an effective means for overrotating teeth when that procedure is indicated. After the rotations have been accomplished, the levers remain in place as active antirotation retainers.

IDEAL TREATMENT IN A CLASS II MALOCCLUSION

Fig. 4 illustrates a Class II, Division 1 malocclusion which gives every evidence of responding favorably to treatment. Indications for edgewise therapy are so ideal that it appears that the appliance was designed specifically for this particular case.

Although the posterior teeth presented a typical Class II relation, the deeper supporting structures were adequate for comprehensive treatment. The bite was closed, as is characteristic of most of these cases. This was due, for the most part, to an excessive curve of Spee in the mandibular arch, with possibly an equal division between elevated anterior teeth and posterior teeth that did not quite achieve full eruption.

Considered separately, each arch was well developed, so much so that spaces existed between virtually all the teeth. All teeth were well formed except the maxillary lateral incisors; these teeth failed to reach their normal size and proportion when related to other dental structures. The only other complication was the failure of the left first premolars to meet when the teeth were in occlusion. The mandibular premolar was not only in a Class II relation with the maxillary premolar; it also was displaced completely to the lingual of the maxillary premolar.

Adequate mandibular anchorage was the key to successful treatment. Because of the interproximal spaces between the teeth, the mandibular posterior segments would tolerate moderate mesial movement and still permit

lingual repositioning of the mandibular incisors. But the anchorage for Class II elastics had to be firm and stable. In cases such as this, the edgewise appliance is capable of supplying this anchorage, provided the mandibular second molars are a part of the appliance assembly. By their inclusion, fourteen teeth were available for mandibular resistance.

Anchorage effectiveness was increased further by moderate tip-back bends in the posterior segments and mild lingual crown torque on the anterior teeth. It was also reinforced with extraoral anchorage on the maxillary arch at night.

The intraoral photographs in Fig. 4 illustrate the appliance in one of the final stages in treatment. All teeth except the maxillary cuspids had been banded from the beginning. It is apparent that these cuspids now require brackets to move them somewhat gingivally. These photographs also show

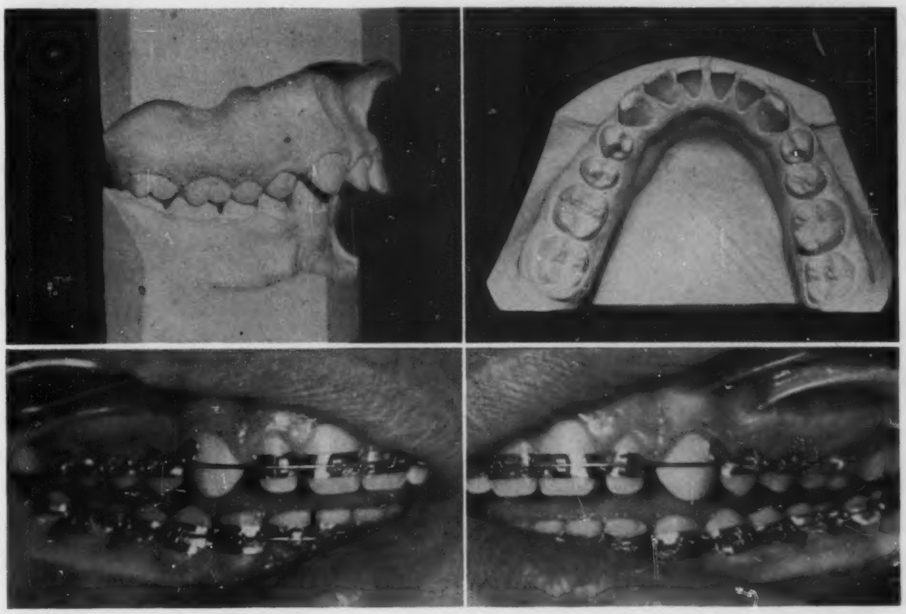


Fig. 4.—Extensive spacing in mandibular arch in this Class II, Division 1 malocclusion permitted ideal treatment with the edgewise appliance. Close-bite is corrected, occlusal relations are normal, and the mandibular incisors have been repositioned lingually over basal bone.

that the incisors have attained a normal overbite and overjet. Mesiodistal relations are normal, and the excessive curve of Spee in the mandibular arch has been so reduced that the occlusal plane appears to be flat. A secure attachment on each tooth is necessary if depressed and elevated teeth are to be brought into an even alignment. It was accomplished in this case with the usual sequence of leveling arch wires before the insertion of the rectangular arch.

A word of caution is indicated at this point. In the usual crowded malocclusion, anterior teeth will tip labially on the insertion of ideal arch wires in brackets on incisors. They have no place to go except forward; it is one

form of undesirable expansion. The four incisors in each arch are the weakest of all teeth, and they will move labially beyond the limits of basal bone while the larger number of sturdy posterior teeth remain undisturbed. This will occur even though the crowding is moderate. Proper correction of crowded incisors calls for distal movement of cuspids and premolars before attempting to realign the anterior teeth over the apical base. In the case being discussed, only the presence of spaces throughout both arches made it safe to band all the teeth and place ideal arches at the beginning of treatment.

STAGES IN TREATMENT OF A SEVERE CLASS I MALOCCLUSION

Fig. 5 illustrates an extreme Class I malocclusion with narrow arches, inadequate arch length, and an extremely irregular alignment of the anterior teeth. Cuspids are rotated and tipped to the labial, three of the lateral incisors are in definite lingual malposition, and the maxillary left central incisor is elevated and displaced labially. Radiographic examination also showed impaction of the mandibular third molars. All the evidence—models, photographs, and radiograms—led to the conclusion that extraction of first premolars was an essential part of treatment.

Following extraction, the maxillary cuspids were carried distally with springs extending buccally and gingivally from an acrylic plate. The mandibular cuspids were moved distally with auxiliary springs attached to a passive rectangular arch wire. No attempt was made at this stage to realign the anterior teeth; every precaution was taken to protect anchorage during distal cuspid movement. As a result, there was no improvement in the positions of the maxillary incisors when the plate was discontinued.

Fig. 5 illustrates the sequence in which the edgewise bands were placed for the correction of the maxillary anterior teeth. As the lateral incisors were moved labially, the arch wire was permitted to rest on the left central incisor, thus causing lingual movement of this tooth. However, it still maintained a slight labial inclination and the right central incisor was inclined somewhat to the distal. The next stage of treatment called for bands on these teeth and further correction of the inclinations of all the cuspids and premolars.

Brackets are so located on incisors that they are parallel to the long axes of these teeth. Thus, the band on the maxillary right central incisor is angulated so that, as the arch wire passes through the bracket, it will act to correct the distal inclination of this tooth. This correction is illustrated in Fig. 5; the same photograph also shows another view of a rotating lever on the distal of the maxillary left lateral incisor.

Bands were now placed to depress the maxillary cuspids and to complete the edgewise assembly. Anterior teeth already are in reasonably acceptable alignment at this stage, and the posterior teeth show that only minor adjustments are necessary to complete the correction of the inclinations of those teeth.

The last two photographs show final results six months after the insertion of retainers. The case gives every evidence of remaining stable following removal of artificial retention, although extraction of slightly impacted third molars may be necessary before releasing the mandibular teeth from all mechanical support.

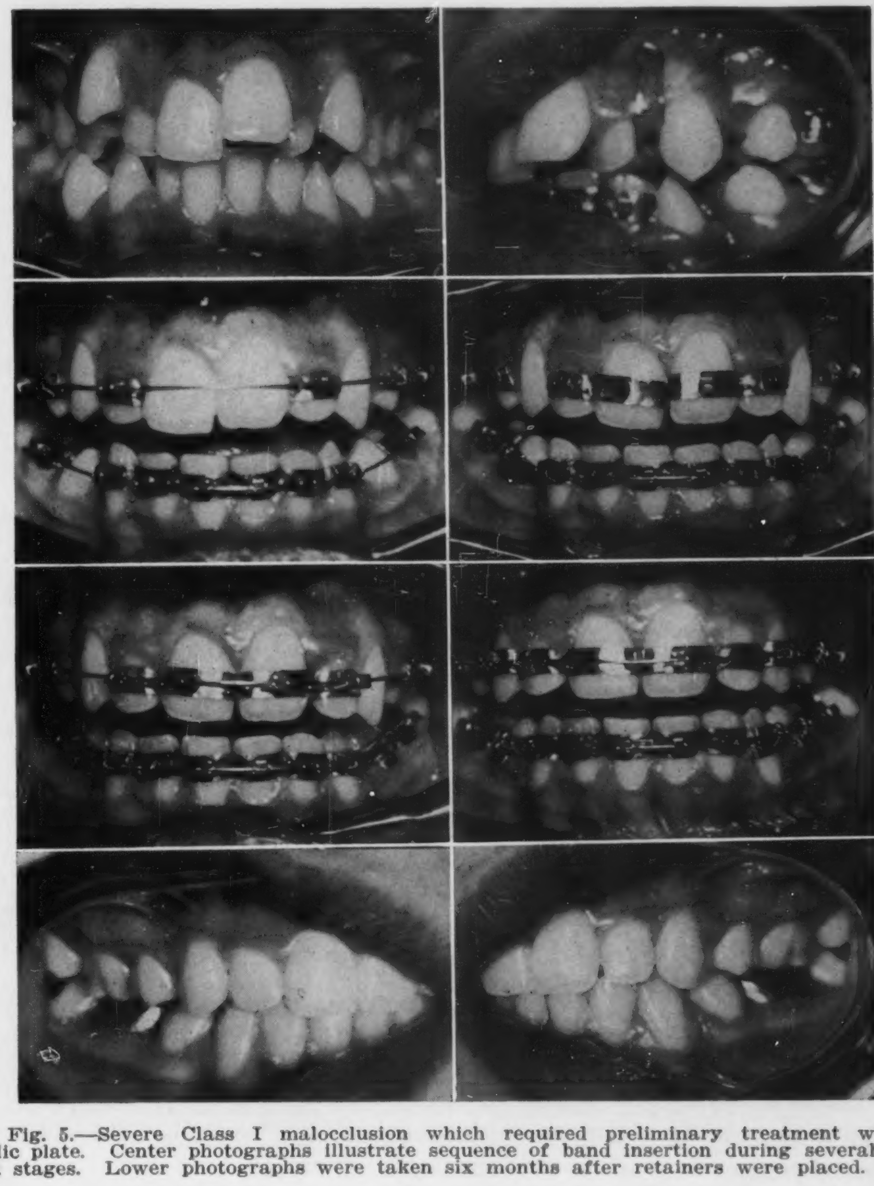


Fig. 5.—Severe Class I malocclusion which required preliminary treatment with an acrylic plate. Center photographs illustrate sequence of band insertion during several treatment stages. Lower photographs were taken six months after retainers were placed.

BRACKET EFFICIENCY IN INDIVIDUAL TOOTH MOVEMENT

The efficiency of the edgewise bracket in individual tooth movement is illustrated in the Class I malocclusion shown in Fig. 6. This series of photographs is concerned principally with the distal movement of the mandibular

left cuspid. This tooth was not only displaced labially; it also presented an unusual distal inclination. This meant that the root apex would have to be moved farther distally than the crown if a correct axial inclination was to be attained following closure of the first premolar space. Otherwise, the case presented no particular problem in space-closing procedures.

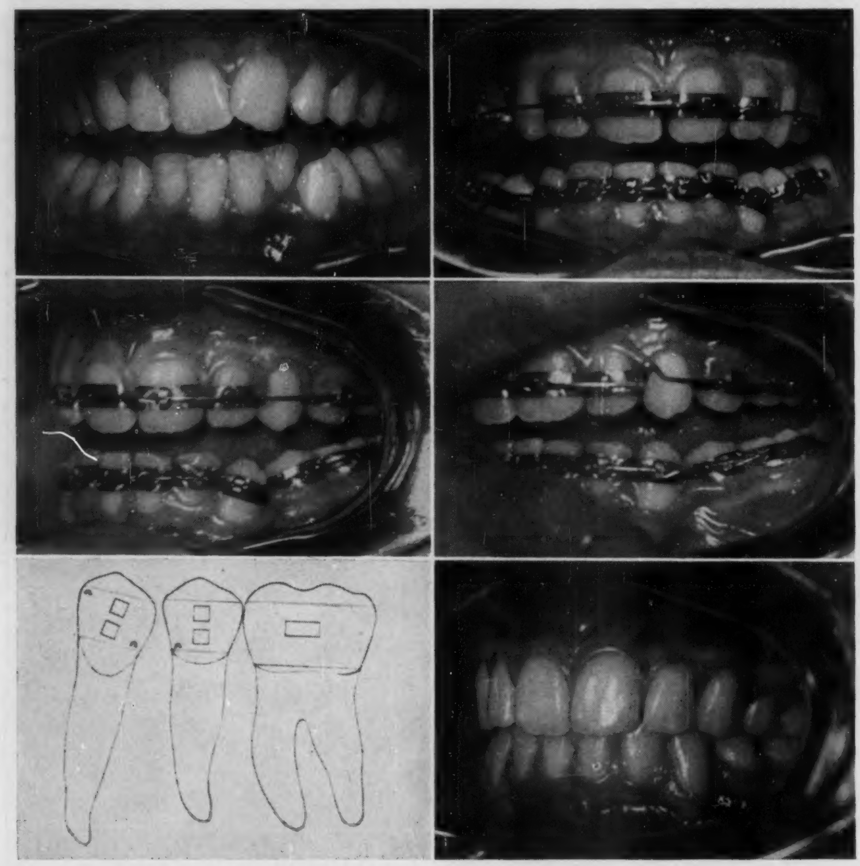


Fig. 6.—An excessive distal inclination of the mandibular left cuspid is evident in this first premolar extraction case. Drawing illustrates increase in angulation of cuspid bracket to secure distal root movement.

Two photographs illustrate the appliance as it was placed following the extraction of the four first premolars. The left side is shown to illustrate the distal inclination of the cuspid and the position of the bracket opening at right angles to the long axis of the tooth. A horizontal arch wire passing through a bracket at this inclination acts to elevate the cuspid and to move the apex distally.

A pull-coil spring also was utilized to create distal movement of the tooth. Its posterior attachment was the distal end of the arch wire. A spur was soldered on the wire to prevent mesial movement of the molar. The spring was tied to the cuspid bracket so that the tooth would rotate as it moved distally. If the tooth had not required rotation, the spring would have been

tied to a staple soldered distally and gingivally to the bracket—distally to prevent rotation and gingivally to encourage distal root movement as well as distal crown movement.

The right center photograph in Fig. 6 illustrates the change in the position of this mandibular cuspid following eight weeks of treatment. Although space closure is not complete, there is moderate improvement in its axial inclination. However, it still tips too far distally and the second premolar also shows a mesial inclination.

Theoretically, an arch wire passing through a bracket at right angles to the long axis of a tooth should correct its axial inclination. Practically, the bracket loses its efficiency as the tooth approaches its vertical or upright position. Further correction requires an alteration in bracket position or a compensating bend in the arch wire.

The usual method of improving the positions of teeth with perverted axial inclinations is to place corrective bends in the arch wire. This is not difficult to do but, if not done accurately, the bends may distort the wire and thereby affect the positions of the adjacent teeth.

These bends are particularly treacherous in the curved portion of the arch wire between the anterior and posterior arch segments, which means the cuspid area. In contrast, tip-back bends in the premolar and molar region may be made with assurance because they are located in one plane in space in a relatively straight line.

Tip-back bends for molars and premolars, moreover, are uniform. Their intent is to tip all the posterior teeth in the same direction—distally. This cuspid, however, requires a difficult reverse bend. It already tips distally; it demands a complicated bend in the opposite direction to move the root distally while the crown remains relatively stationary.

A more accurate means to accomplish this movement is to alter the angle of the bracket on the cuspid.[11] Since this is difficult to pick up photographically, a line drawing is shown to illustrate the increase in the angulation of the cuspid bracket. Instead of being parallel to the long axis of the tooth, the bracket has been altered so that it tips distally more than the cuspid itself. A straight arch wire passing through a bracket opening at this increased angle automatically tends to correct the axial inclination of the tooth. Distal root movement occurs without unduly disturbing the adjacent teeth.

The cuspid staples also have been placed in the positions of greatest mechanical advantage in this drawing. If the tooth needs to be rotated, the direction of pull from either ligature will favor distal root movement. If both staples are tied to the arch wire, they will have a reciprocal action which will also aid the angulated bracket in uprighting the cuspid.

The mesiogingival staple on the premolar serves three purposes. As this tooth moves forward in space-closing procedures, it tends to rotate—mesial surface to the lingual. A ligature to a mesial staple prevents this rotation.

In a gingival position, it also acts to elevate the mesial side of the premolar—a desirable action if its vertical position is to be maintained as the crown moves mesially. After the cuspid and premolar have been brought into contact, their gingival staples can be ligated together. As the ligature is tightened, the contact areas act as a fulcrum which again favors parallel root relations. Meanwhile, other corrections can be completed elsewhere in the arch with no fear of relapse at the site of the extraction.

In the drawing, a change in bracket inclination is shown only on the cuspid. This was done so that attention would be centered on this one tooth in a study of the mechanics of bracket angulation. In actual practice, the second premolar bracket and the first molar tube also are altered so that they have a slight mesial inclination. At this angle, the tube and bracket act as a substitute for tip-back bends, which also makes for greater ease in duplicating the successive arch wires. In this manner, posterior anchorage is protected and the tendency for these teeth to tip mesially as they move forward is discouraged. These changes in bracket angulation should be anticipated when the bands are placed, and, as indicated by the cuspid, are moderate in degree.

Final results eight months following retention are shown in the last photograph in Fig. 6. Both the mandibular cuspid and the second premolar now present normal axial inclinations, occlusal relations are good, first premolar spaces are closed, and the anterior teeth are well positioned directly over basal bone. In the final stages of treatment, the maxillary cuspid also had been banded to correct a slight rotation and to improve its axial inclination.

COIL SPRINGS AND VERTICAL LOOPS

Reference has been made to the use of pull-coil springs in space-closing procedures. Fig. 7 illustrates their application. One end of the coil is attached securely to the distal end of the arch wire, and the molar is stabilized with a stop spur mesial to the molar tube. The mesial end of the coil is then ligated under tension to a distogingival staple on the cuspid band. If the cuspid is to be rotated, the coil is ligated to the bracket. The springs in this illustration had been activated three weeks before the photograph was taken, and spaces already are beginning to appear between the cuspids and lateral incisors.

Fig. 7 also illustrates the application of a push-coil spring for distal movement of cuspids. It is slipped around the arch wire before insertion on the teeth. A push-coil spring is space-wound so that it can be compressed between the brackets before they are ligated to the arch wire. The action is reciprocal; each cuspid receives an equal amount of pressure in a distal direction. The chief objection to the use of push-coil springs is that they tend to rotate teeth as pressure is applied. Antirotation ligatures are therefore required to counteract this tendency.

Coil springs are used, for the most part, for individual tooth movement in the initial stages of treatment. After the cuspids have been carried

distally in these cases, new arch wires with vertical loops are placed to complete space closure throughout the arches. Fig. 7 illustrates vertical loops that were used to close extraction spaces in a case that also presented an open-bite and tongue thrust.

Vertical loops are activated by ligating the arch wire to the molar tubes, or by bending the wire gingivally at the distal end of the molar tubes. Usually the loops are placed at the site of the extraction in the posterior segments of the arch wire, as is shown in the mandibular arch. In this maxillary arch, however, they were placed between the cuspids and lateral incisors. In this position, the elastics have a slight posterior pull on the maxillary incisors which offsets the forward thrust of the tongue on these teeth.

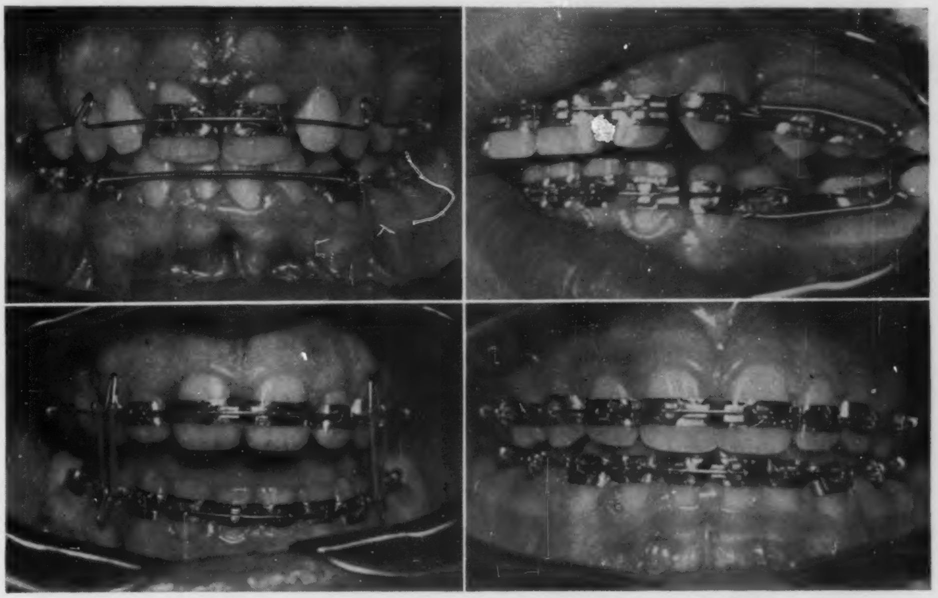


Fig. 7.—Four different appliances illustrate push-coil spring on upper left, pull-coil springs on upper right, vertical spring loops and vertical elastics on lower left, and a complete edgewise assembly in a final treatment stage on the lower right.

TREATMENT OF SEVERE CLASS II, DIVISION 1 IRREGULARITIES

A typical severe Class II, Division 1 malocclusion is illustrated in Fig. 8. At best, treatment procedures are discouraging in these extreme cases. Maxillary and mandibular apical base relations are most unfavorable. Mandibular development is markedly deficient, and this deficiency is located in each ramus as much as it is in the body of the mandible. This is apparent from the steep Frankfort-mandibular plane angle.

Unfortunately, orthodontic treatment has little or no influence on the deeper supporting structures of the mandible (none at the symphysis and questionable in extent at the condyles). This same limitation in potential development also is present in the alveolar structures, just as it is in Class

I mandibles with deficient arch length. For these reasons, it simply is not possible to create new mandibular growth by moving anterior teeth labially; the result, instead, will be a forward displacement of these teeth beyond the limits of the mandibular supporting bone.

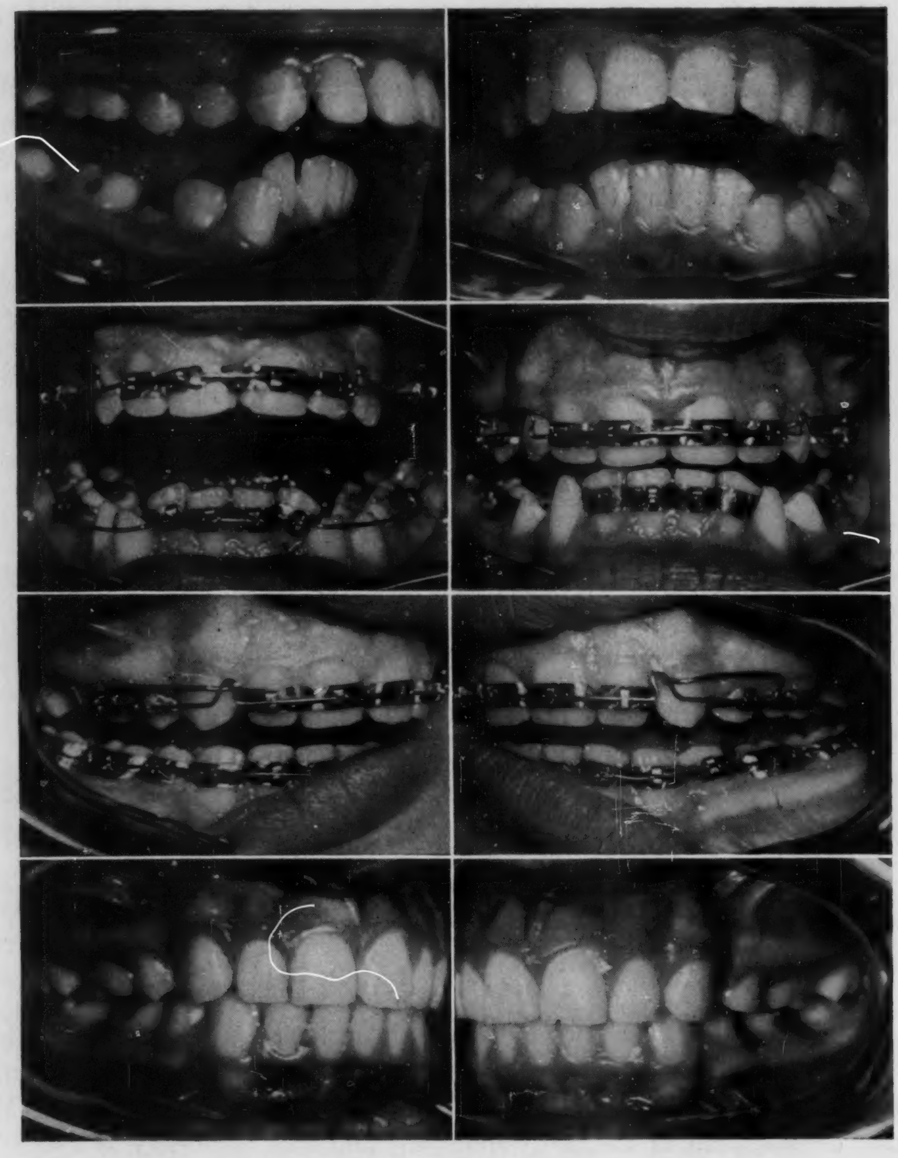


Fig. 8.—Class II, Division 1 extraction case treated by retracting maxillary anterior teeth as first step in treatment. Mandibular first premolars were retained in early stages to reinforce Class II anchorage and extraoral traction. Final results are shown in lower photographs.

In contrast, maxillary growth has exceeded the normal range of variation. Orthodontic correction can reduce only in part this maxillary prominence; much of it will have to be accomplished by changing the labial inclination of

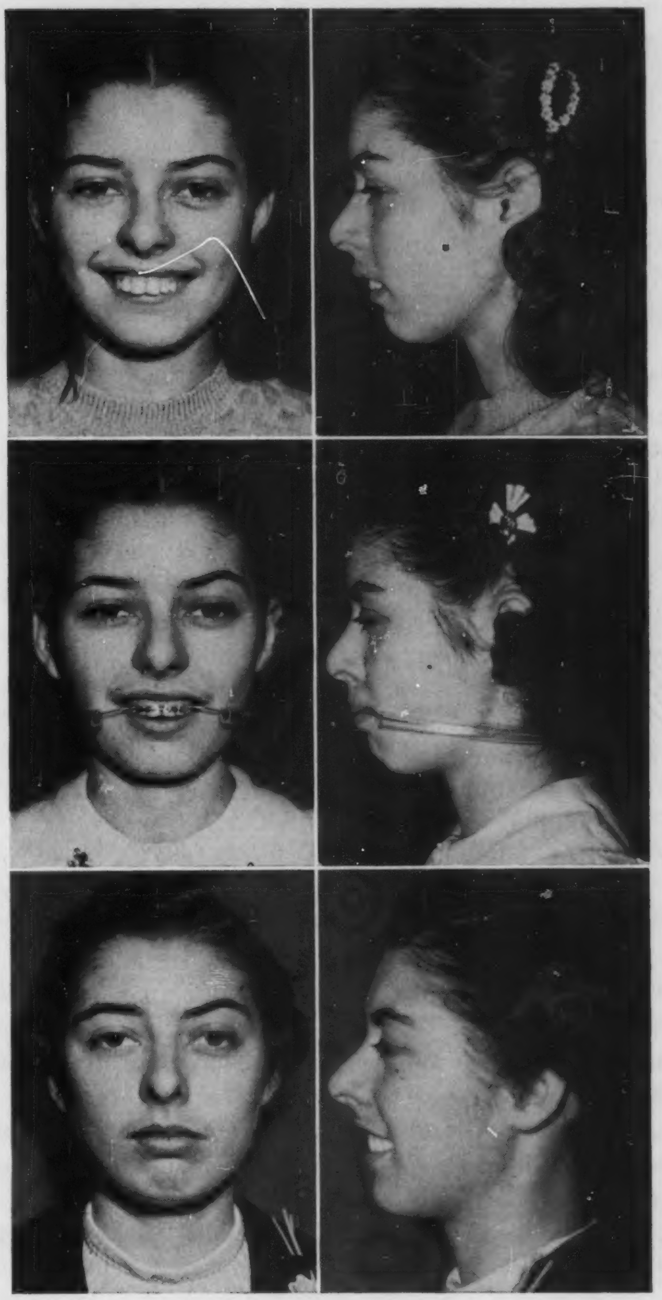


Fig. 9.—Photographs of patient shown in Fig. 8. Center photographs illustrate cervical traction with plastic tube. Lower photographs show changes in maxillary incisor position and improvement in facial contours as a result of treatment.

the maxillary incisors to a definite lingual inclination. Only by this means can a reasonably acceptable overjet be achieved between the maxillary and mandibular anterior teeth.

For doing these things, two procedures are essential if failure is to be avoided: (1) mandibular anchorage must be protected at all times and (2) maxillary reduction must be achieved by some form of extraoral traction.

Various means of establishing mandibular anchorage have been reported in Class II extraction cases, any of which might have been applied in this irregularity. One of the most widely accepted methods is to extract the mandibular first premolars at once. The mandibular posterior teeth are then moved and tipped distally, and the mandibular anterior teeth are realigned over basal bone with a lingual inclination. This requires the use of Class III elastics, and is termed *anchorage preparation*.[12] Extraoral traction is used on the maxillary arch to offset the action of the Class III elastics on the maxillary teeth. In this method, the maxillary first premolars usually are left undisturbed until mandibular anchorage has been established. They are then extracted and Class II mechanics are begun.

Treatment in this case, however, deviated from the usual method in that extraction in the mandibular arch was not undertaken until after the maxillary incisors had been carried lingually and the maxillary cuspids had been moved distally into the first premolar extraction spaces. This decision was based on the concept that mandibular anchor units left undisturbed in alveolar bone provide the most stable resistance. In addition, retained mandibular first premolars in themselves add to anchorage stability by preventing a mesial movement of posterior teeth into the extraction spaces. In this procedure, moreover, the undesirable forward action of Class III elastics on the maxillary arch is avoided.

The original appliance assembly, as shown in Fig. 8, consisted of bands on the eight incisors, the maxillary second premolars, the four first molars, and, in addition, on the two mandibular second molars to increase anchorage stability in the mandibular arch.

Every effort was made to protect mandibular anchorage. A rectangular arch wire was carefully adapted in a passive manner into each bracket so that the mandibular teeth would require the minimum of reorganization of the supporting alveolar bone. This rectangular arch wire was not preceded by the usual sequence of round steel wires to align the brackets, for these leveling arches tend to break down the resistance provided by the normal undisturbed alveolar bone. Moderate tip-back bends were placed in the molar region, however, on the premise that the best anchorage is secured when the anchor units are established with a slight distal inclination. A slight reverse curve of Spee was also placed in the arch wire to correct the closed bite; this was necessary to permit lingual repositioning of the maxillary anterior teeth. Stop spurs were also soldered on the mandibular arch wire mesial to the second molar tubes to prevent their forward movement.

Ordinarily, the mandibular cuspids would also be banded to increase mandibular anchorage. In this case, however, they presented a distinct labial

inclination at a much lower level than the incisors. Any attempt at adapting a rectangular wire passively on teeth in this position would be extremely difficult, if not impossible. Loss of anterior anchorage would be the more probable result.

The first step in treatment was designed to exert continuous pressure in a lingual direction on the maxillary anterior teeth, with as little stress as possible on the mandibular arch. Light Class II elastics were worn during the daytime, and strong extraoral traction was applied to the maxillary arch at night. An 0.022 inch round steel arch wire with Class II loops was placed on the maxillary arch. A round wire permits the anterior teeth to tip lingually; a rectangular wire would have required undesirable bodily movement. The usual spurs mesial to the maxillary molar tubes were omitted so that the arch wire would slip distally through the tubes as the anterior teeth moved lingually.

CERVICAL ANCHORAGE TO SUPPLEMENT CLASS II ELASTICS

Either occipital or cervical anchorage may be used to supplement the intraoral Class II elastics. In this case, wire hooks extending from a plastic cervical tube were attached to the Class II loops on the maxillary arch wire (Fig. 9). Traction was derived from rubber bands secured to the posterior ends of the wires within the tube. The amount of pressure is determined by the reaction of the teeth; it should be strong enough to cause moderate tenderness following eight or ten hours' application.

After the maxillary anterior teeth had been moved lingually, the mandibular first premolars were extracted. Distal movement of the mandibular cuspids was accomplished first with auxiliary springs and later with pull-coil springs extending from the second molars to staples soldered distally and gingivally to the cuspid brackets. During this period, cervical traction was placed on the mandibular arch to help maintain the mandibular incisors in their original positions overlying basal bone.

Fig. 8 illustrates right and left intraoral views of the appliances and the relation of the dental arches at this stage. A reverse curve of Spee had been placed in the mandibular arch wire to correct the elevated incisors. These photographs also show corrective bands in the mandibular cuspid regions to cause the roots of these teeth to move distally to improve their axial inclinations. At this time, bands were also placed on the maxillary cuspids to correct their inclinations.

Final results are illustrated in the last two photographs. They show that the excessive curve of Spee has been fully corrected and that the anterior teeth are reasonably well located over basal bone. The posterior teeth present acceptable mesiodistal occlusal relations, first premolar spaces are closed, overjet and overbite are within normal range, and teeth are vertical and upright on either side of the extraction areas.

The posttreatment photographs in Fig. 9 illustrate the facial improvement that was achieved. The profile view, in particular, shows that the maxillary

six anterior teeth have been moved lingually and distally as far as upper facial esthetics would permit. Further mandibular growth was desirable but not obtainable.

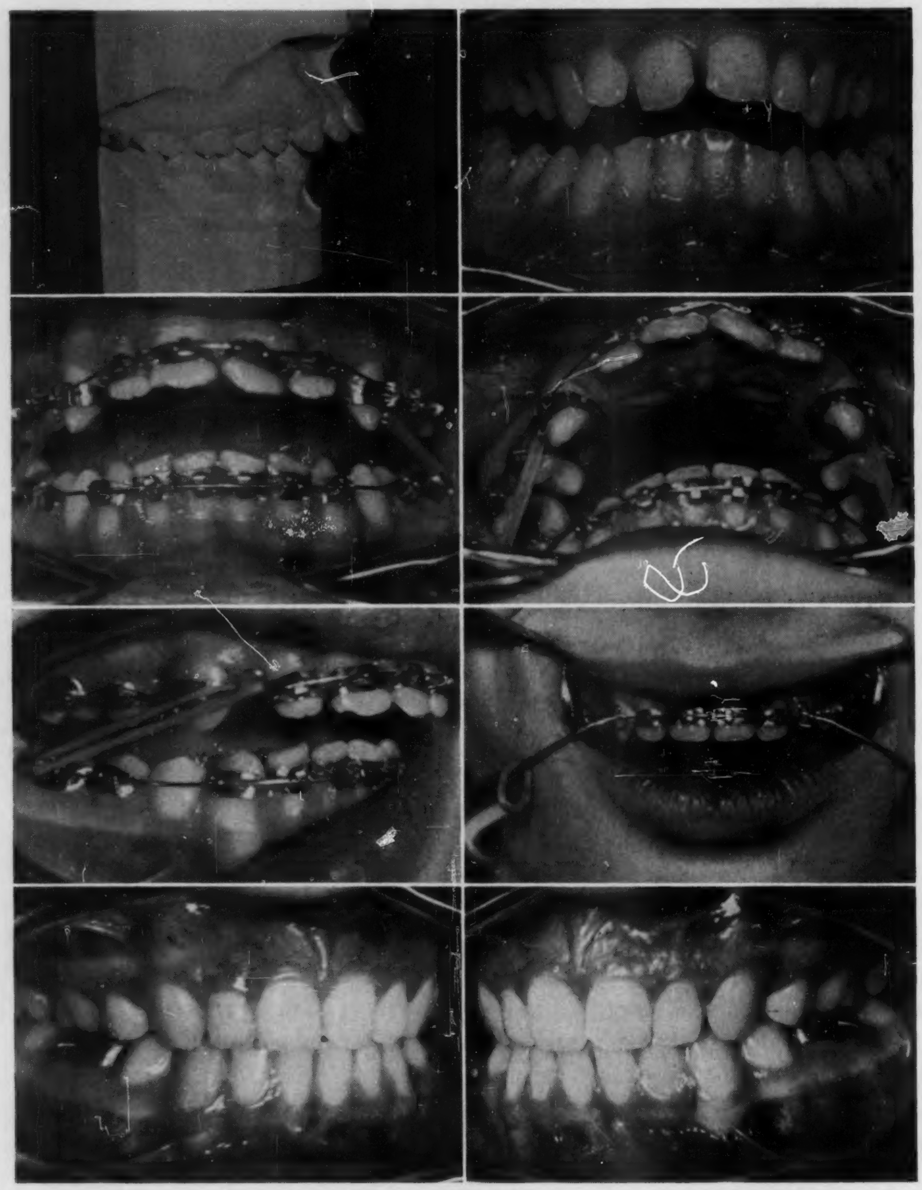


Fig. 10.—Class II, Division 1 extraction case treated by retracting maxillary cuspids as first step in treatment. Also shown is type of extraoral traction used to relieve mandibular anchorage. Lower photographs illustrate final results eleven months following insertion of retainers.

VARIATIONS IN CLASS II TREATMENT POSSIBILITIES

The case illustrated in Fig. 10 is also a typical Class II, Division 1 malocclusion. It is shown to demonstrate the wide variation in treatment possibilities with the edgewise appliance. It was also to be a four first pre-

Fig. 11.—Photographs of patient shown in Fig. 10. Class II facial structures are illustrated in original photographs. Improvement in facial balance and proportion are apparent in center and lower photographs taken following treatment.

molar extraction case, but again the mandibular first premolars were left in place during the early stages to help stabilize mandibular anchorage.

The mandibular incisors were well positioned directly over basal bone. Unfortunately, several growth factors deny the possibility of moving these teeth labially. No new bone of consequence is laid down in the anterior portion of the mandible after the age of 6 years, or earlier. Therefore, growth once lost in this area cannot be regained by appliance manipulation.

Alveolar bone, moreover, is normally narrower in the mandibular incisor region than in any other section of the dental arches. This limits the amount of labial movement that can be expected of the mandibular anterior teeth during treatment. This, in turn, means that if a normal overjet of incisors is to be attained, it will have to be accomplished, for the most part, by changing the inclination of the maxillary anterior teeth from a labial to a lingual inclination. Once again, conservation of mandibular anchorage is of the greatest importance.

The mandibular cuspids were in a more favorable position than in the previous case, so they were included in the original appliance assembly to increase anchorage stability. All teeth were banded except the first premolars, which were already extracted in the maxillary arch and to be extracted in the mandibular arch after they had served their purpose in supporting mandibular anchorage.

In this treatment variation, the first step is to move the maxillary cuspids distally, and all the teeth, maxillary as well as mandibular, are used as anchorage. Passive rectangular arch wires for this purpose were carefully adapted into the brackets in both arches. Anchorage was reinforced with slight distal tip-back bends, and spurs were soldered mesially to each of the four molar tubes. The maxillary rectangular arch was also rounded by grinding in the cuspid areas so that the brackets would slide more easily along the wire as the cuspids moved distally.

Intermaxillary hooks were soldered directly to the maxillary cuspid bands at their disto-occlusal margins. Continuous pressure in a distal direction was then applied to the maxillary cuspids—part of the time by Class II elastics from the mandibular molars to the hooks on the maxillary cuspids, and part of the time by pull-coil springs from the maxillary molars to the maxillary cuspids. Each arch thus alternated as a source of anchorage. While one was under tension the other was resting, but distal traction was constant on the maxillary cuspids.

After these cuspids had been moved into contact with the second premolars, the maxillary arch wire was replaced with an 0.022 inch round steel wire with Class II loops for intermaxillary elastics and extraoral attachment. Its purpose was to move and tip the maxillary incisors lingually. To do this, a moderate reverse curve of Spee was necessary in the mandibular arch wire to depress the mandibular incisors. No other change was made in this pas-

sive rectangular wire; mandibular anchorage still had to be protected. For this reason, the Class II elastics were light and were worn during the daytime only.

Strong extraoral traction from a cervical tube was applied at night. Thus, mandibular anchorage again was under stress only part of the time, but the maxillary incisors were under continuous pressure in a lingual direction. In due time, they were carried lingually to a reasonably acceptable relation with their mandibular opponents.

Meanwhile, the mandibular anterior teeth had maintained their positions virtually undisturbed over basal bone, and retention of the mandibular first premolars had effectively restrained mesial movement of the first molars and second premolars. No correction had yet been attempted for the Class II relation of the posterior teeth.

The mandibular first premolars were now extracted. Further lingual movement of anterior teeth in both arches was accomplished with vertical loops in new rectangular arch wires. Extraoral anchorage was continued on the maxillary arch, and intermaxillary elastics were used to correct the Class II molar relation.

The final photographs in Fig. 10 illustrate results eleven months after retention was placed. There was no change during this period. Occlusal relations are good, anterior teeth retain acceptable positions over basal bone, overbite and overjet are within normal range, and the teeth on either side of the extraction areas are upright and vertical.

Fig. 11 illustrates the original Class II facial characteristics, with pronounced maxillary structures and retarded mandibular growth. The final photographs illustrate improvement in facial contours, although mandibular development remains somewhat deficient. To mask this deficiency, the maxillary anterior teeth had been moved lingually as far as upper facial esthetics would permit. The general appearance is favorable, with relaxed and passive musculature, and a friendly, pleasing smile.

CONCLUSION

An attempt has been made to describe the clinical application of the edgewise appliance in actual practice. As with any other appliance, technical details are too complicated to cover completely in a single article. Certain techniques, moreover, cannot be described; they must be demonstrated, and again, as with any other appliance, different operators have different methods. Nevertheless, an effort has been made to illustrate basic technical procedures, step by step, in eight separate cases.

Unfortunately, it was not possible to include individual case analyses or current thought on such controversial issues as expansion, extraction, growth and development, and cephalometric diagnosis. Time and space limitations made it necessary to confine this article to the assigned topic—the clinical application of the edgewise appliance in orthodontic treatment.

REFERENCES

1. Angle, Edward H.: The Latest and Best in Orthodontic Mechanism, Dental Cosmos **70**: 1143-1156, 1928; **71**: 164-174, 260-270, 409-421, 1929.
2. Hotz, Rudolf: Orthodontie in der Taglichen Praxis, Bern and Stuttgart, 1954, Hans Huber.
3. Kjellgren, Birger: Serial Extraction as a Corrective Procedure in Dental Orthopedic Therapy, Tr. European Orthodontic Society, 1947-1948, pp. 134-160.
4. Nord, Ch. F. L.: Orthodontics for the Masses, D. Record **67**: 263-267, 1947.
5. Schwarz, A. Martin: Lehrgang der Gebissregelung, Vienna, 1953, Urban and Schwarzenberg, vol. 2.
6. Heath, John: The Interception of Malocclusion by Planned Serial Extraction, New Zealand D. J. **49**: 77-88, 1953.
7. Dewel, B. F.: Serial Extraction in Orthodontics: Indications, Objectives, and Treatment Procedures, Am. J. Orthodontics **40**: 906-926, 1954.
8. Thompson, John R.: Personal communication, 1952.
9. Lewis, Paul D.: Space Closure in Extraction Cases, Am. J. Orthodontics **36**: 172-191, 1950.
10. Dewel, B. F.: Second Premolar Extraction in Orthodontics: Principles, Procedures, and Case Analysis, Am. J. Orthodontics **41**: 107-120, 1955.
11. Holdaway, Reed A.: Bracket Angulation as Applied to the Edgewise Appliance, Angle Orthodontist **22**: 227-236, 1952.
12. Tweed, Charles H.: The Application of the Principles of the Edgewise Arch in the Treatment of Malocclusions, Angle Orthodontist **11**: 12-67, 1941.

708 Church St.

DIAGNOSIS AND TREATMENT PLANNING

PHILIP E. ADAMS, D.M.D., BOSTON, MASS.

SALZMANN,[1] in the second edition of his *Principles of Orthodontics,* prefaces Chapter 12, entitled "Classification and Diagnosis of Dentofacial Anomalies," with the following statement:

"In order to diagnose deviations from normal dentofacial development in the individual patient, it is necessary to have some common norm as a basis. Since individual variation is the rule in nature, there can be no norm or structural unit representative of the human species as a whole because a common basis or norm is, nevertheless, necessary in order to classify dentofacial deformities, for the purpose of treatment, certain workers in the field of orthodontics, notably Carabelli, Angle, Case, Lischer, Simon and Hellman, to mention only a few, created such norms and classifications. While we recognize the shortcomings of all norms, we can readily agree with Simon that 'the normal is, nevertheless, a necessary fiction.' "

Discussing orthodontic diagnosis further, he[1] states: "Diagnosis in orthodontics is concerned with determining the nature of a dentofacial deformity in relation to certain dental, facial and cephalometric norms. It is chiefly concerned with the recognition of deviations from a biometric norm, just as etiology is chiefly concerned with the factors responsible for morphologic, physiologic and pathologic deviations from the norm."

In an article entitled "Diagnosis in Orthodontics: Theory and Practice," Salzmann[2] states:

"Diagnosis in orthodontics actually includes consideration of the following:

"1. Etiologic factors responsible for the deviations from the accepted anatomic norm.

"2. Classification of the anomaly according to the type or direction of deviation from the accepted dentofacial norm.

"3. Correlation of etiology and classification with the maturative age of the patient, including bone age and nutritional status.

"These three factors must be ascertained as accurately as possible in order to decide on the time, type, intensity, direction, and duration of treatment."

Read before the Southern Society of Orthodontists, Charlotte, North Carolina, September, 1955.

In a classification of etiological factors, Salzmann[2] lists the following:

1. Prenatal causative factors.
   a. Genetic or hereditary—those transmitted by the genes.
   b. Differentiative—those which are inborn or engrafted upon the body in the prefunctional, embryonic developmental stage.
   c. Congenital—those which may be hereditary or acquired, but which exist at birth.
2. Postnatal causative factors.
   a. Developmental—those which manifest themselves during the active growth period.
   b. Functional—those due to lack of, or faulty function or to overfunction.
   c. Environmental or acquired.

In the same article, Salzmann points out that:

Types of classification according to various norms may be summarized as follows:

1. Tooth and jaw relationship—Angle.
2. Skull and denture relationship—Simon, Broadbent.
3. Facial growth related to dental development—Hellman.

These three references, it would appear to me, epitomize in a brief but orderly manner those things with which orthodontic diagnosis is concerned and the factors which must be considered in an orthodontic diagnosis.

For many years the "ideal normal" of Angle, based on the morphology of the teeth and their relation to each other both in the same arch and between the two arches, was the standard in orthodontic diagnosis and treatment planning. Angle's insistence on the perfection of interdental relations with a full complement of teeth dominated orthodontic thought for many years.

In 1921 Hellman[3] published an article entitled "Variation in Occlusion." His conclusions were that normal occlusion of the teeth, conceived by the orthodontist to present 100 per cent perfection, is a myth. It has no biologic justification and no scientific foundation. The type of occlusion in man is shown to be represented by a masticatory apparatus with an average of approximately 90 per cent perfect and a standard deviation of approximately 6 per cent.

Thus, when the standard is determined statistically we possess a biometric norm. While it may be reasonably argued that this standard falls short as a standard for comparison in the individual case, it at least has the scientific validity of being one that actually occurs in Nature.

In 1920 A. LeRoy Johnson[4] coined the term "individual normal" to differentiate between two standards to which the word "normal" refers. He used

the term "species normal" to denote the typical anatomic parts and their relations. He used "individual normal" to denote a standard of parts and their relations in the individual.

The introduction of the concept is of value, as "we should remember, in our diagnosis of borderline cases, that we are concerned with a biologic problem and that the imperfection in occlusal relations or alignment of the teeth that carries a case just beyond the limits of type may not indicate a perversion of physiological processes."[5]

At about this same time, Case[6] was emphasizing the importance of dento-facial harmony. He states: "In a diagnosis and prognosis of malocclusion, a disregard of facial outlines and the marring effects which malrelations of the teeth and jaws produce, or a belief that 'the attainment of a normal occlusion will always result in the most perfect correction of dento-facial imperfections and disharmonies,' is rapidly taking its rightful place as one of the fantastic theories of the past."

In 1941 Tweed,[7] in Part 1 of his paper on "The Application of the Principles of the Edgewise Arch in the Treatment of Malocclusion," concludes, from his own experience, that the establishment of a reasonably satisfactory cuspal relationship, regardless of the axial inclinations or the relation of the teeth to their respective bony bases, will not result in a redirection of growth processes so that the maxillary and mandibular base bones will themselves grow forward and under the mesially positioned teeth.

In this same paper, Tweed defines his concept of the normal as a mandible slightly anterior to the true position in relation to the skull, individual anterior teeth in the mandible upright or vertical, and no protrusion of the alveolar process in the lower incisal region. Tweed concedes that differences of type should, of course, be considered but his version of the normal allows for no variations.

Tweed's concept of the normal and, more particularly, the attendant therapeutic measures he advocates for its attainment have been opposed by numerous authors.

We find, at the present time, two schools of thought in relation to treatment objectives—on the one hand, those who adhere to the original concepts of Angle, with possibly some concessions to standards and norms which have been developed over the years and, on the other hand, those who have as treatment objectives an esthetic result based on an upright relation of the incisors and a straight profile.

Perusal of the literature, as well as observations of the clinical application of orthodontic mechanotherapy in the hands of various orthodontists, leaves little doubt that current orthodontic diagnosis and treatment planning are based upon widely divergent concepts.

There seems little likelihood that these differences will be resolved in the immediate future, if ever. Therefore, it would seem the wiser course to discuss at this time basic diagnostic data that the individual practitioner can apply in attaining the treatment objectives which he feels are most desirable. There

has developed over the years a fairly comprehensive idea of what constitutes the essential records and observations upon which diagnosis and treatment planning are based.

It would no doubt be of great value to have a complete medical history of the patient and the patient's family, basal metabolism tests, blood count, urinalysis, endocrine assessment, etc., but in actual practice this may well prove impractical. In those cases where indications warrant, the patient's physician should be consulted.

The records and observations that I have found useful are as follows:

History Before Treatment.—Weight at birth that falls within normal ranges probably has little significance. A low weight at birth, particularly if it is coupled with a birth date following closely on previous children, may indicate an inherent feebleness of growth due to the fatigue of the mother, as suggested by Jansen.[8]

Other children in the family: This information may suggest, where children are closely spaced, the possibility of inherent feebleness of growth as previously suggested. The examination of siblings may disclose significant similarities in dentofacial patterns, which may prove helpful in assessing the limitations of treatment imposed by genetic factors.

Nutrition (bottle- or breast-fed): With the attention given infant feeding in relation to formula, there is little likelihood that the nutritional aspect is greatly affected, whether the child is breast- or bottle-fed. There is an apparent correlation between type of feeding (bottle or breast), frequency of feeding, time and type of weaning, and the establishment of atypical swallowing habits, sucking habits, and other muscular perversions.

Problems in early feeding should be recorded.

What sickness has patient had? Frequent and protracted illness, even the usual childhood diseases, may indicate a low resistance which may stem from an inherent feebleness of growth.

The medical history may be significant in children showing a generally low growth rate with poorly synchronized height and weight ratios.

Obviously, any chronic condtion disclosed in the medical history may be important in assessing growth potentials and predicting growth patterns.

Habits: Type of habit and duration and intensity of habit, if these can be determined, if not now a factor, may be helpful in determining the etiology of the malocclusion.

Condition of occlusion of other members of family: There seems to be sufficient evidence that genetic factors are important in the development of malocclusion to make it advisable to determine as far as possible what limitations may be imposed by inheritance.

Family health: There has developed a considerable body of evidence that the general health of the children in a family may be associated with the general health of their parents. There are certainly positive correlations in certain diseases and diathesis in others.

Muscle coordination (age at which patient began to walk): Normal variation in the age at which the child begins to walk may be expected. Long delay in walking may suggest deep-seated neuromuscular imbalances which are reflected in poor posture and, as the muscles of the dentofacial complex are part of the chain that balances the head, neuromuscular imbalances or perversions at an early age may influence the development of the bony parts to which they are attached.

Birth (normal or instrument): While the number of cases in which injury by instrument at birth is so small as to be virtually insignificant, the fact of instrument birth suggests the possibility of intrauterine pressures and difficulties of passage through the birth canal. These have been advanced as of etiologic significance. Difficulty in differentiating between intrauterine pressures and genetic factors must be recognized.

The information developed by the history before treatment may disclose pertinent information useful in diagnosis and treatment planning. One must agree with Donovan[9] that, "It is the wiser policy in the majority of instances to begin the diagnosis on conditions actually present, not on a fancied theory of etiology." However, we cannot afford to miss an important etiologic factor, if such exists, in a given case, for, as most authorities agree, etiology may well determine the type, degree, intensity, and time of treatment.

Observations at Beginning of Treatment.—Age, height, and weight should be correlated and any significant variation in either height or weight ratios with age should be noted. The ratio of height and weight is a practical measure of physical progress. Numerous tables are available for reference. A variation of less than 10 per cent is not considered significant; beyond that a medical checkup is indicated.

The dental formula is included for ready reference without checking models.

The general condition of the mouth is a significant observation. Mouths with an extremely high caries attack rate have to be assessed on the relative value of orthodontic interference in relation to the life of the teeth and the possible cooperation of the patient in mouth care. Cases with a moderate attack rate present problems in relation to patient cooperation. All cases with poor mouth hygiene present problems that must be discussed with the parent; a decision must be reached as to responsibility of patient and parent or whether treatment procedures should be delayed until better cooperation has been demonstrated.

Present diet: In most cases, an adequate diet may be assumed. Occasionally strong dislikes for essential food elements may be found, even to the extent where deficiencies may be reflected in the condition of the oral tissues, which may prohibit orthodontic interference until such deficiencies are corrected.

Breathing (normal or mouth): Mouth breathing may be caused by nasal obstruction, either present or past (where nasal passages have been cleared but no breathing exercises inaugurated, with the consequence that the mouth

breathing persists), or it may be present with clear nasal passages and be due entirely to the positions of the anterior teeth with an associated difficulty of lip closure.

Were adenoids and tonsils removed? When? Were breathing exercises prescribed?

Lips: Relative tonicity of the lips should be checked and correlated with the position of the teeth and tongue. Age changes in relative activity of the tongue and lips should be considered in the assessment.

Tongue: Size as related to its confines within the bones and teeth. Perversions of activity; infantile swallowing habits; macroglossia; tongue thrusting; tongue biting; and correlation with age as noted above.

Gingivae: Relative health of the soft tissues surrounding the teeth may reflect constitutional factors, such as dietary disturbances, blood dyscrasias, Dilantin sodium therapy, etc., and local factors, such as poor mouth hygiene, root fragments, extensive caries, poor restorative dentistry, etc. Correction of these conditions may be necessary before orthodontic work is initiated. Median spacing with deep-seated frenum is recorded and correlated with x-ray pictures of the area.

General health: As in the history before treatment, persistent and prolonged periods of poor health may be responsible for a general lowering of the whole bodily economy with consequent reflection in the increments of growth. Growth may be impeded at critical times as the dentofacial complex unfolds.

Habits still existing: Obviously if a pernicious habit of etiological significance still exists, its influence must be assessed and the possibility of its elimination considered. It is important to point out to the parent its possible influence and the necessity of its elimination if it is of etiological significance.

Mental attitude: Cooperation of the patient is essential in all cases. It is particularly important in those cases in which appliances or appliance auxiliaries are under the control of the patient. Again, in the consultation with the parent this necessity of cooperative effort should be stressed and the consequences of failure to secure it pointed out.

Character of mastication (normal, vigorous, or feeble): While there appears to be some difference of opinion as to the relative parts played by function and pure growth, as dictated by the inherent growth potentials of the individual, it seems to be generally agreed that function has a molding influence on the structures involved and relative muscle tonicity may well play an important part in cases involving changes in dental height as well as general development of the arches.

Remarks on x-ray examination: Presence or absence of third molars (correlated to age), missing or supernumary teeth, medial clefts (failure of nasal processes to join in development), and pathology, if present, are all recorded here. Cephalometric data are recorded on the tracings.

Etiology, if ascertainable, is recorded.

Diagnosis: Classification and pertinent data relative to case assessment are recorded.

Prognosis (whether favorable or conditional): This may be divided if case presents necessity of sectional or intermittent treatment.

Weight record: The upper section is used for original record, and additional observations if original shows significant variations. The lower section is used for weight record when significant variation indicates desirability of checking frequently.

The dental casts, which in many offices are an unoriented record of the dentures, show the relations of the individual teeth to each other in the same jaw and, when they are placed on their heels, are trimmed to record the relation of the two dentures to each other in centric relation.

The dental casts may be utilized to assess the relation of tooth material to basal structures. This may be accomplished by following the suggested methods of Howes,[10] Nance,[11] Rees,[12] Ballard and Wylie,[13] or Carey,[14] or modifications of these methods. To be utilized for these assessments, it is necessary that the anatomic portion of the model extend, at least from first molar to first molar, to the mucobuccal fold.

Cephalometric Roentgenograms.—Undoubtedly, a complete cephalometric appraisal should be based on four cephalometric x-ray pictures—one lateral with the teeth in occlusion, one lateral at rest position, one anteroposterior, and one lateral with the mouth wide open. Zeisse[15] describes a method of combining the rest position x-ray and wide-open mouth x-ray on one film by using a lead screen over the upper half of the film during the exposure and then reversing the cassette for the second. In my own practice, I take a lateral x-ray with the teeth in occlusion on every case and supplement this with additional films if the intraoral examination indicates that problems in relation to occlusal interference exist.

Various head positioners have been described in the literature; therefore, no description of the apparatus will be given.

There are numerous methods of cephalometric appraisal in current use.[16-20] Each is basically concerned with an effort to appraise the facial pattern and determine the spatial relations of the facial structures, cranial structures, and dental structures.

The Downs[16] analysis is based upon ten areas of assessment:

> *Downs' Frankfort Horizontal.*—Right and left cephalometric porion and the left orbital. (Tweed's 4½ mm. above porion.)
>
> Facial angle is an expression of the degree of recession or protrusion of the chin. Range, 82 to 95 degrees; mean 87.8 degrees; standard deviation, 3.57.
>
> *Angle of Convexity.*—This is a measure of the protrusion of the maxillary part of the face to the total profile. Range, +10 to −8.5 degrees; mean, 0; standard deviation, 5.09.

A–B to Facial.—This measure of the relationship of the anterior limit of the denture bases to each other and to the profile permits estimation of the difficulty the operator will meet in gaining correct incisal relationships and satisfactory axial inclinations of these teeth. Range, 0 to –9 degrees; mean, –4.8 degrees; standard deviation, 3.67.

Mandibular Plane Angle.—This measure of the relationship between the Frankfort plane and a tangent to the lower border of the mandible is used by some as a clinical diagnostic aid.

Range, 28 to 17 degrees; mean, 21.9 degrees; standard deviation, 3.24. Correlation between the mandibular plane angle and the facial angle indicates that as the facial angle decreases, the mandibular plane angle tends to increase.

Y Axis.—This expresses, in a measure, the path of facial structures as they move downward and forward. Range, 66 to 53 degrees; mean, 59.4 degrees; standard deviation, 3.82.

Cant of Occlusal Plane.—Angular relation between occlusal plane and Frankfort plane. Range, +14 to +1.5 degrees; mean, +9.3 degrees; standard deviation, 3.83. Correlation between this plane and the facial angle indicates a tendency for the occlusal and Frankfort planes to approach parallelism as the facial angle increases. (Should the relationship exceed parallelism through a drop of the posterior end of the occlusal plane, the readings are made in minus degrees.)

Axial Inclination of Upper and Lower Incisors.—This is a measure of procumbency of the incisor teeth.

Range, 130 to 150.5 degrees; mean, 135.4 degrees; standard deviation, 5.76.

Axial Inclination of Mandibular Incisors to Mandibular Plane.—Range, using 90 degrees as base, –8.5 to +7 degrees; mean, 91.4 degrees; standard deviation, 3.78.

Axial Inclination of Lower Incisors to the Occlusal Plane.—The inferior inside angle was read and the plus or minus deviation from a right angle was recorded. Range, +3.5 to +20 degrees; mean, +14.5 degrees; standard deviation, 3.48.

Protrusion of Maxillary Incisors.—The distance of the incisal edge of the maxillary central incisor to the line A–P is a measure of maxillary dental protrusion. Range, 5 mm. (anterior) to –1 mm. (posterior) to A–P line; mean, 2.7 mm.

There are variations between individuals in downward and forward direction of growth of the face. There are three possibilities to consider: (1) horizontal and vertical growth may be equal, in which case the direction of growth (Y axis) will not change; (2) horizontal growth will exceed vertical growth (Y axis angle will decrease, indicating a forward swing of the face); (3) vertical growth exceeds horizontal growth and the Y axis angle increases.

The ten figures used in the appraisal do describe skeletal and denture relationship, but single readings are not so important; what counts is the manner in which they all fit together and their correlation with type, function, and esthetics.

Four facial types that are in balance and harmony have been described by Downs:[21] (A) retrognathic; (B) mesognathic; (C) prognathic; and (D) true prognathism.

One standard deviation, plus or minus, will include 68.26 per cent of the sample. Two standard deviations will include 95.46 per cent. More than two standard deviations from the mean can be assumed to represent an unsatisfactory proportion.

Salzmann,[22] in a recent editorial on cephalometrics, points out that, in an article entitled "Adolescent Age Changes in Sagittal Jaw Relation, Alveolar Prognathy, and Incisal Inclination," Björk and Palling[42] state "The value of biometrical methods in clinical diagnosis depends entirely on the user's appreciation of the limitations inherent in the method. Cephalometric methods of analysis, especially growth analysis, can be extremely valuable but presupposes a thorough knowledge of normal and biometrical methods. Failing this, such methods may prove difficult to understand and may even be misleading."

Krogman,[23] in an article entitled "Craniometry and Cephalometry as Research Tools in Growth of Head and Face," points out "*. . . there are no absolutely fixed points in the growing head and face: there are only relatively stable points.*"

"The type is a complex whole, the sum of all parts. Similarly, it is urged upon the cephalometrician that no one dimension, no one angle, no difference of a few millimeters or of a few degrees in an angle can assume a type difference that is of absolute diagnostic value."

Thompson[24] has investigated and reported the significance of the rest position of the mandible. His opinion is that the rest position is a better index of the position of the mandible as dictated by muscular forces than the centric relation, which may be dictated by occlusal relations of the teeth.

Wylie[25] has outlined a method of assessment of anteroposterior dysplasia whereby discrepancies in size of facial bones occurring in the anteroposterior plane of space may be assessed quantitatively in terms of millimeters. The method of assessment makes possible a net score of anteroposterior dysplasia which is approximately zero where such dysplasia is either nonexistent or compensated for by variation in different parts, and which is negative in the type of face where relative mandibular insufficiency exists and positive in cases of mandibular prognathism.

Wylie and Johnson[26] have worked out a set of transparencies for the assessment of vertical dysplasia from lateral cephalometric films. The data upon which these transparencies were based show that subjective evaluation

tends toward "poor" when lower face height becomes large, when ramus height becomes short, when the angle of the mandible becomes large, and when placement of the glenoid fossa of the temporal bone is relatively high.

These are some of the applications of cephalometrics to a better understanding of dentofacial morphology; there are many studies in the literature based on cephalometric analysis which merit perusal by those interested.

Routine x-ray examination consists of lateral jaw right and left views taken on an 8 by 10 inch film with a lead shield covering the half not being exposed, four occlusal films of the four canine areas (these include the anterior teeth and premolars), and two bite-wing films of the molar-premolar areas. If extraction is contemplated, intraoral films of the canine-premolar areas are also taken. When the patient has a medial diastema, an intraoral film is taken to check for medial cleft. If weight and height records do not correlate with chronologic age, hand and wrist x-rays are used to determine skeletal age.

Intraoral photographs are taken full face, right and left, and across the anterior teeth to show the horizontal overjet. Extraoral photographs are taken in the cephalometer which provides an oriented profile and full-face photograph. A stereotach attachment is used in my office which provides a three-dimensional photograph.

When we have secured all the record material in the form of histories, casts, x-rays, photographs, and cephalometric data, we must analyze it to determine where and to what degree the case under analysis varies from an acceptable pattern, whether such deviations are correctable by orthodontic means, and what the nature and sequence of our corrective measures shall be.

Our success in this area will depend largely on the basic knowledge we possess in the fields of anatomy, physiology, embryology, growth and development of the head, and other related sciences plus our ability to correlate our case analysis with existing orthodontic procedures designed to bring about desired changes.

The scope of this presentation could not encompass a review of the necessary basic knowledge referred to above, but we might review with profit some of the studies that relate to intraoral factors affecting case assessment. I am going to quote extensively from an article by Moyers and collaborators.[27] I have taken the liberty of interpolating within the quoted material.

The authors point out that the original position of the tooth (pre-eruptive) is largely genetically determined. The conformation of the arch is, for the most part, a genetically controlled matter.

"*Intra-alveolar Eruption.*—Variations in the start of intra-alveolar eruption, at least for the permanent teeth, are far more likely to be due to local factors than to endocrine or other systemic conditions."

"*Speed of Eruption.*—It should be remembered that three processes are interrelated in eruption—interrelated, but not necessarily interdependent. These are the development of the root, the resorption of the deciduous

predecessor, and the growth of the alveolus. Carlson* has shown that eruption is not highly correlated to the rate of root lengthening. Nor is the resorption of deciduous roots dependent entirely upon the eruption of the permanent tooth. Finally, as Massler and Schour** have pointed out, both the alveolus and tooth are moving in the same direction, but at different rates, and not always simultaneously. In the absence of local factors the speed of eruption seems to be under genetic and endocrine control."

"*Local Factors Interfering With Eruption.*—Among the local causes which may impede or deflect an erupting tooth are such obvious things as supernumerary teeth, cysts, tumors, and retained deciduous root fragments. . . . Occasionally one root of a primary molar resorbs faster than another. This may permit the premolar to tip or rotate to an abnormal position."

Failure of primary root resorption may occur with or without ankylosis. Following the progress of primary tooth resorption by radiograms should be carried out as a prophylactic procedure in case assessment.

In those cases where primary root resorption has not taken place in a normal manner, through either complete failure to resorb or unequal resorption, causing a deflection of the permanent successor, it may be necessary to reposition the deflected tooth as advocated by Holland[28] if the developmental level of the root permits.

"*Local Factors Hastening Eruption.*—Periapical pathology in primary teeth usually means hyperemia and resorption of bone in the region of the lesion. Since there is less bone to erupt through, the permanent successor usually erupts faster."

Loss of primary teeth while there is a significant amount of bone between the primary tooth and its permanent successor may result in the formation of a bone cap which may or may not resorb and allow the permanent tooth to erupt. These cases should be followed carefully by serial radiograms; if the bone over the permanent tooth is not resorbing, it should be removed surgically.

Intraoral Eruption.—"As the tooth breaks through the oral mucosa, it enters the potential dental space along the alveolus. . . . Its future position, in fact normal occlusion, now largely depends on the hormonious interrelationship of three entities: (a) the immediate muscular environment, (b) basal bone orientation, and (c) the dental size—dental space ratio."

The authors believe that during the first ten years of life jaw and alveolar growth is proceeding at a faster rate than tongue growth. This tends to diminish the effects of the powerful tongue support and to enhance the effects of the lips and cheeks. "Proximal tooth contact then is required in the permanent dentition for arch stability to withstand the inward force of the outer muscle band.

---

*Carlson, Harry: Studies on the Rate and Amount of Eruption on Certain Human Teeth, Angle Orthodontist **18**: 33-35, 1948.

Massler, Maury, and Schour, Isaac: Studies in Tooth Development: The Growth Pattern of Human Teeth, J. A. D. A. **27: 1778-93, 1918-31, 1940.

"Any disturbance of posture or function of the tongue, lips, and cheeks, then, has immediate consequences in terms of eruptive direction of the tooth, dental arch form, and occlusion. The normality of the muscle mold may be disturbed by abnormal habits, disease, or accidents."

"The anatomic entity of two occluding arches is maintained by two groups of physiologic influences. In the horizontal plane, forward directive influences are the tongue, the buccinator at the tuberosity, and the anterior component of occlusal influence. These are resisted by the horizontal muscle band of the lips and cheeks containing the dental arches. In the vertical plane, the teeth are maintained up to the level of the occlusal plane by the alveolar growth influence. This is continuous throughout life.

"Any possible tendencies of alveolar growth to force the jaws apart are controlled by the vertically acting masticatory muscles. These antagonistic influences are in equilibrium at the jaw position of occlusal contact, which is a few millimeters closed from the position when the muscles are at physiologic rest. This interval is called by Thompson* 'freeway space'."

These observations are so fundamental in nature that they appear obvious; however, their significance is frequently overlooked in case assessment.

In the serial observation of cases, an opportunity is afforded to check the sequence of eruption of the permanent teeth.

Lo and Moyers[29] reported on a study of the sequence of eruption of the permanent dentition designed to determine:

"a. Whether or not the sequence of eruption of the permanent dentition affects the final occlusion.

"b. Which sequence of eruption is seen most frequently.

"c. What type of occlusion occurs as a result of the different sequences of eruption."

"No sexual differences were noted in the sequence of eruption within either dental arch when the entire series was studied. However, when noting the order of eruption in normal occlusions only, the seventh tooth to erupt in the male child is the maxillary first premolar, the eighth, the mandibular canine. In the female child these two teeth appear in reverse order."

Factors affecting the sex differences and the sequence of eruption are discussed. The authors present the following conclusions:

"1. The most frequently seen sequence in the maxilla is 6 1 2 4 5 3 7.

"2. The most frequently seen sequence in the mandible is 6 1 2 3 4 5 7.

"3. The combination of eruption sequences 6 1 2 4 5 3 7 in the maxilla and 6 1 2 3 4 5 7 in the mandible provides the greatest incidence of normal molar relationships.

"4. The most unfavorable sequence in the maxilla was that in which the second molar erupted earlier than either the premolars or cuspid.

*Thompson, J. R.: A Cephalometric Study of the Movements of the Mandible, J. A. D. A. 28: 750-761, 1941.

"5. The most unfavorable sequences in the mandible were those in which the cuspids erupted later than the premolars or when the second molar erupted prior to either the cuspid or premolars.

"6. In cases of Class II molar relationship there is a strong tendency for the maxillary molars to erupt prior to their mandibular counterparts.

"7. More female than male children demonstrated the normal sequence and resultant proper molar relationship.

"8. There is prognostic value in studying the sequence of eruption in the radiogram prior to the loss of the deciduous teeth."

Intelligent application of this knowledge in serial observation can do much to minimize or eliminate the effects of atypical sequence of eruption of the permanent teeth.

Numerous investigators have developed criteria to assist in case assessment. We have previously mentioned the work of Nance,[11] Rees,[12] and Howes,[10] which are all concerned with the proportional relationship of the tooth material to its supporting bone.

Rees[12] presents a method of determining the proportional relationship of apical bases and contact diameters of the teeth. Measurements are taken from the casts, which must be accurate, and special attention must be given to the extension into the mucobuccal fold in order to approximate basal bone to at least the distal surface of the first molar. A line is drawn on the model at the mesial contact point of each first permanent molar and a third line is drawn through the midline contact of upper or lower central incisors. This line is extended to a point 8 to 10 mm. from the gingival margin in an apical direction. A piece of Scotch tape, 5 inches long and ⅛ inch wide, is superimposed upon a molar mark. The tape is pressed firmly to the cast to pass through the incisor point and then through the opposite molar point. It is cut off at the latter molar point, removed from the cast, and placed along a line on a ruled card. The teeth on each cast, from second premolar to second premolar are recorded at their greatest mesiodistal diameter with small dividers and the distance is worked on a line of the same card. The length of the apical base, as represented by the tape and total mesiodistal diameters of the teeth, can be measured easily with a millimeter ruler for comparison. A chart, based upon measurements of relations of teeth to base in normal untreated occlusions, is shown in the article by Rees.[12]

"By comparing the table of average normals to the measurements taken on any set of casts, we are able to determine with reasonable accuracy the following points of diagnostic significance:

"1. The relation of apical base to the teeth of each arch. If a discrepancy exists, the amount is important; in cases that are borderline, internal and external muscular forces, facial esthetics, and other factors will determine our treatment plan.

"2. The relation of maxillary to mandibular base. Where a discrepancy exists between the opposing arches, reduction of teeth and base may be necessary in one arch, or if this is not indicated, an expansion of the other arch is the only other alternative. . . .

"3. The relation of tooth size in maxillary to mandibular arches. Where discrepancies beyond normal range are present, we are faced with spacing or crowding in our finished case. . . ."

Ballard and Wylie[13] developed a chart for mixed dentition case analysis by which the size of the unerupted canine and premolars could be predicted from the combined measurement of the four lower incisors.

Tweed,[30] in 1945, stated: "The normal relationships of the mandibular incisor teeth to their basal bone is the most reliable guide in the diagnosis and treatment of all Class I, Class II, and bimaxillary protrusion types of malocclusions, and to the attainment of the objective of balance and harmony of facial lines and permanence of tooth positions. Such positioning of the teeth often requires the sacrifice of dental units."

"In normal occlusion the mandibular incisors are always positioned in mandibular basal bone within the range of the normal variation of minus 5 to plus 5."

Obviously, this low range of variation would be true only when applied to Tweed's concept of the normal. Other investigators have established wider ranges of variation of this angle in relation to their concept of the normal.

In 1946, Tweed,[31] discussing the Frankfort-mandibular plane angle in orthodontic diagnosis, classifications, treatment planning, and prognosis, summarized as follows:

> "1. In cases that fall within the Frankfort-mandibular plane angle range of 16° to 28°, the prognosis varies from excellent for those nearest the 16° extreme to good for those cases nearest the 28° extreme.
>
> "2. In cases that fall within the Frankfort-mandibular plane angle range of 28° to 32°, the prognosis will vary from good at 28° to fair at the 32° extreme.
>
> "3. In cases that fall within the Frankfort-mandibular plane angle range of 32° to 35°, the prognosis is fair at 32° and not favorable at 35°.
>
> "4. In cases that fall within the Frankfort-mandibular plane angle of 35° upward, prognosis is not favorable at 35° and virtually nil at extremes such as 45° to 55°."

In a recent article, Tweed[32] introduced the Frankfort-mandibular incisor angle (FMIA) as a criterion in orthodontic diagnosis, treatment planning, and prognosis. Taking the Frankfort-mandibular angle of 25 degrees (range, 20 to 30 degrees), previously utilized as a diagnostic aid, and the inclination of the lower incisors of 90 degrees (range, 85 to 95 degrees) as related to the mandibular plane, also previously used as a diagnostic aid, he completes the triangle by a line from the mandibular plane angle through the long axis of

the lower incisor to the Frankfort horizontal which automatically would become 65 degrees. He places the dividing line between extraction and nonextraction at 62 degrees (FIMA), with certain exceptions where analysis discloses that the patient is not a discrepancy case, that the mandibular incisors are not irregular, and that facial esthetics are fair.

That these diagnostic criteria based upon the incisal angle, the mandibular plane angle, or the Frankfort-mandibular incisor angle, have value in diagnosis and treatment planning is an accepted fact. That any one of them can be accepted as the sole basis of diagnosis and treatment planning seems open to question.

In a recent article, Graber[33] states: "If we must use a norm as a guide, does it not seem plausible to determine the facial type first, and pick the norm for that type? As valid as this may be in Class I (Angle) malocclusions, it is in Class II, Division 1 types that the real difference is noted. In a study of 150 Class II, Division 1 cases just completed, the apical base difference averages 5.5 degrees, as contrasted to 2.5 degrees in a group with clinically excellent occlusions. In one phase of this study, anteroposterior apical base difference was correlated with the S-N—mandibular plane angle, the latter supposedly a guide for the severity of the problem. A thorough biometric analysis revealed an insignificant statistical relationship. Specifically, what does this mean? It means, first, that we are not facing facts about facial relationships if we arbitrarily predetermine inclination of individual teeth, ignoring qualifying variations in apical base relationships. The mandibular incisors may have an inclination of 85, 90, 95, or 99 degrees and still be normal, depending on facial type and maxillomandibular relationship. Second, *the clinical impression of the validity of the mandibular plane angle as a prognostic guide would not appear to be substantiated in Class II malocclusions* on the basis of the degree of anteroposterior basal dysplasia, the most important characteristic of a Class II (Angle) malocclusion."

Wylie,[34] in an analysis of Tweed's article entitled "The Frankfort-Mandibular Incisor Angle (FMIA) in Orthodontic Diagnosis, Treatment Planning and Prognosis, uses scattergrams to show the relatively low correlation between net changes in soft tissue convexity and net changes of angle of lower incisor to lower border, also net change of soft tissue to lingual movement of lower incisor edge in millimeters and to uprighting upper incisors (angular change to N A plane).

In his summary, Wylie[34] states: "Modification of the facial profile by orthodontic means depends on other factors besides the inclination of anterior teeth, so much so that diagnostic criteria based solely on this factor are likely to be unreliable. Examination of Tweed's treated cases shows unmistakably, that clinically he does what he sets out to do. It also shows, however, that skillful treatment and a seeming ability to elicit mandibular growth is more responsible for his success than merely the establishment of a specific angulation for the mandibular incisor.

"Caution must always be observed in assigning cause and effect relationships, particularly when results are good, lest we assign credit to the wrong factor and fail to obtain the results we admire. Those who admire Dr. Tweed's results are advised to direct their attention to the painstaking clinical procedures he has developed over the years, rather than to the Frankfort mandibular angle."

A review of the literature, particularly of the last decade, reveals an increasing awareness of the problem posed by the infinite variation seen in the individual case. The studies of Moore and Hughes[35] on "Familiar Factors in Dentofacial Disturbances" point out the extensive operation of heredity in the production of features in the dentofacial complex. Berger[36] is of the belief that disrelation may be on a pathologic, constitutional and hereditary, or phylogenetic basis. A. LeRoy Johnson assessed the dentitions of dogs used by Stockard[37] to test experimentally his (Stockard's) views on the endocrine basis of constitutions, and concluded: "There is considerable probability that similar relations will be found to hold for man, since the disturbances of facial growth in the human infant and child are so readily comparable to the conditions in the skull of the puppy."

Ernest Johnson,[38] in discussing the relation of the Frankfort-mandibular plane angle to the facial pattern, observes: "There may be a great deviation in the individual pattern from the so-called 'normal' or ideal type or pattern. Yet, these extremes are in one sense normal for that individual, and many of the individual deviations from the acceptable pattern are not within the realm of orthodontic correction."

These are but a few of the references to this problem which can be summed up by a quotation from Wylie[39]: "I see malocclusion as disproportion between facial parts—parts which in themselves may be within the limits of normal variation, but which are disproportionate when combined with other facial structures and lead therefore to a disproportionate whole."

"The hypothesis is that nature has combined the parts of the face in a random fashion, with little regard for how well they go together, and that the efforts of orthodontists will be better rewarded if they are directed toward working out the best clinical procedures for dealing with accepted disproportions than if they are expended on speculation as to why disproportion is encountered in the face of man, when in truth infinite variety is a fundamental fact of nature."

If we recognize malocclusion as disproportion between facial parts, and I believe that we must, we must channel our treatment planning toward the attainment in the individual patient of the best result possible with full cognizance of the limitations imposed by the individual's dentofacial complex.

Jackson[40] has stated: "Objectives of orthodontic treatment can be quite clearly and simply defined as structural balance, functional efficiency, and esthetic harmony." He has elaborated on these in his many contributions to orthodontic literature.

Bercu Fischer,[41] in discussing asymmetries of the dentofacial complex, suggests: "The stock of concrete orthodontic elements is made up of units of malocclusion, such malrelations as overjets, overbites, crowding, spacing, malrelationships of single teeth, groups of teeth, alveolar arches, jaws, etc."

"In the final analysis, all malocclusions seem to consist of various combinations of these undesirable traits. Since these traits show great variation and are independent of each other, we are confronted by an endless variety of combinations and each individual patient presents a new situation. This I designate as the 'Trait concept of malocclusion.' "

These two authors, and there are many who have expressed similar opinions, offer a method of case assessment based upon the realities of our complex problem. It is up to the individual practitioner to utilize fully the available knowledge and to work out methods of diagnosis and treatment planning in conformity with his own ideals and objectives.

REFERENCES

1. Salzmann, J. A.: Principles of Orthodontics, ed. 2, Philadelphia, 1950, J. B. Lippincott Company.
2. Salzmann, J. A.: Diagnosis in Orthodontics: Theory and Practice, Am. J. Orthodontics and Oral Surg. **28**: 414, 1942.
3. Hellman, Milo: Variation in Occlusion, Dental Cosmos **63**: 618, 1921.
4. Johnson, A. LeRoy: The Meaning of the Normal, Boston M. & S. J. **182**: 237-240, 1920.
5. Johnson, A. LeRoy: Basic Principles of Orthodontia, Reprinted from Dental Cosmos **65**: 379, 503, 596, 719, 845, 957, 1923.
6. Case, Calvin S.: Dental Orthopedia, Chicago, 1921, C. S. Case Company, pp. 181-132.
7. Tweed, Chas. H.: The Application of the Principles of the Edgewise Arch in the Treatment of Malocclusions, Angle Orthodontist **11**: 5-67, 1941.
8. Jansen, Murk: Feebleness of Growth and Congenital Dwarfism, London, 1921, Hodder & Stoughton.
9. Donovan, Robert W.: Recent Research for Diagnosis, Am. J. Orthodontics **40**: 591, 1954.
10. Howes, A. E.: Case Analysis and Treatment Planning Based Upon the Relationship of the Tooth Material to Its Supporting Bone, Am. J. Orthodontics and Oral Surg. **33**: 499, 1947.
11. Nance, H. N.: The Limitations of Orthodontic Treatment, Am. J. Orthodontics and Oral Surg. **33**: 177, 253, 1947.
12. Rees, Denton J.: A Method for Assessing the Proportional Relation of Apical Bases and Contact Diameters of the Teeth, Am. J. Orthodontics **39**: 695, 1953.
13. Ballard, Murray L., and Wylie, Wendell L.: Mixed Dentition Case Analysis—Estimating Size of Unerupted Permanent Teeth, Am. J. Orthodontics and Oral Surg. **33**: 754, 1947.
14. Carey, C. W.: Linear Arch Dimension and Tooth Size, Am. J. Orthodontics **35**: 762, 1949.
15. Zeisse, Carl: Photography and Cephalometry in Daily Orthodontic Practice, Am. J. Orthodontics **37**: 929, 1951.
16. Downs, William B.: Variations in Facial Relationship: Their Significance in Treatment and Prognosis, Am. J. Orthodontics **34**: 812, 1948.
17. Margolis, Herbert I.: Basic Facial Pattern and Its Application in Clinical Orthodontics, Am. J. Orthodontics and Oral Surg. **33**: 631, 1947.
18. Graber, T. M.: New Horizons in Case Analysis—Clinical Cephalometrics, Am. J. Orthodontics **38**: 603, 1952.
19. Steiner, Cecil C.: Cephalometrics for You and Me, Am. J. Orthodontics **39**: 729, 1953.
20. Higley, L. B.: Application of Cephalometric Appraisals to Orthodontic Diagnosis and Treatment, Am. J. Orthodontics **37**: 244, 1951.
21. Downs, William B.: The Role of Cephalometrics in Orthodontic Case Analysis and Diagnosis, Am. J. Orthodontics **38**: 162, 1952.
22. Salzmann, J. A.: Cephalometrics, Cephalometrists, and Orthodontics, Am. J. Orthodontics **41**: 709-711, 1955.
23. Krogman, Wilton Marion: Craniometry and Cephalometry as Research Tools in Growth of Head and Face, Am. J. Orthodontics **37**: 406, 1951.

24. Thompson, John R.: The Rest Position and Its Application to Analysis and Correction of Malocclusion, Angle Orthodontist **19**: 162, 1949.
25. Wylie, Wendell L.: The Assessment of Anteroposterior Dysplasia, Angle Orthodontist **17**: 97, 1947.
26. Wylie, Wendell L., and Johnson, Ernest L.: Rapid Evaluation of Facial Dysplasia in the Vertical Plane, Angle Orthodontist **22**: 165, 1952.
27. Moyers, R. E., Harvold, E., Jenkins, H., Shultis, K., and Crouch, J. Thomas: Intraoral Factors Affecting Case Assessment, AM. J. ORTHODONTICS **40**: 341, 1954.
28. Holland, Daniel J.: A Technique of Surgical Orthodontics, AM. J. ORTHODONTICS **41**: 27, 1955.
29. Lo, Robert T., and Moyers, Robert E.: Studies in the Etiology and Prevention of Malocclusion, AM. J. ORTHODONTICS **39**: 460, 1953.
30. Tweed, Charles H.: A Philosophy of Orthodontic Treatment, AM. J. ORTHODONTICS AND ORAL SURG. **31**: 74, 1945.
31. Tweed, Charles H.: The Frankfort-Mandibular Plane Angle in Orthodontic Diagnosis, Treatment Planning and Prognosis, AM. J. ORTHODONTICS AND ORAL SURG. **31**: 175, 1946.
32. Tweed, Charles H.: The Frankfort-Mandibular Incisor Angle (FMIA) in Orthodontic Diagnosis, Treatment Planning and Prognosis, Angle Orthodontist **24**: 121, 1954.
33. Graber, T. M.: A Critical Review of Clinical Cephalometric Radiography, AM. J. ORTHODONTICS **40**: 1, 1954.
34. Wylie, Wendell L.: The Mandibular Incisor—Its Role in Facial Esthetics, Angle Orthodontist **25**: 32, 1955.
35. Moore, George R., and Hughes, Bryon O.: Familiar Factors in Diagnosis, Treatment and Prognosis of Dentofacial Disturbances, AM. J. ORTHODONTICS AND ORAL SURG. **28**: 603, 1942.
36. Berger, H.: Problem of Extraction in Orthodontics, AM. J. ORTHODONTICS AND ORAL SURG. **31**: 557, 1945.
37. Stockard, Charles R., and collaborators: The Genetic and Endocrine Basis in Differences in the Form and Behavior as Elucidated by Studies of Contrasted Pure Line Dog Breeds and Their Hybrids, Philadelphia, 1941, The Wistar Institute of Anatomy, p. 382.
38. Johnson, Ernest L.: The Frankfort-Mandibular Plane Angle and the Facial Pattern, AM. J. ORTHODONTICS **36**: 516, 1950.
39. Wylie, Wendell L.: Malocclusion, Malady or Malformation, Angle Orthodontist **19**: 3, 1949.
40. Jackson, Andrew F.: Art of Orthodontic Practice, AM. J. ORTHODONTICS **34**: 383, 1948.
41. Fischer, Bercu: Asymmetrics of the Dento-facial Complex, Angle Orthodontist **24**: 179, 1954.
42. Björk, A., and Palling, M.: Adolescent Age Changes in Sagittal Jaw Relation, Alveolar Prognathy, and Incisal Inclination, Acta odont. scandinav. **12**: 201-232, 1955.

106 MARLBOROUGH ST.

LAMINATED ARCHES—THE DOUBLE RIBBON AND DOUBLE EDGEWISE

C. W. Carey, D.D.S., Palo Alto, Calif.

THERE has been a growing tendency to reduce the bulk of metallic labial arch wires used in orthodontic treatment. It was common practice in the first quarter of this century to employ labial wires of 0.040 inch round in precious metal or piano wire, which was a steel alloy. Angle's E arch, in popular use at that time, was a gold-plated nickel silver round wire 0.036 inch in dimension. Then came the ribbon arch of 0.036 by 0.022 inch, which was forced into bracket slots to effect tooth movement. Following this, Angle introduced his edgewise brackets, which were designed to be used with a gold alloy, 0.022 by 0.028 inch arch wire, which was forced into 0.022 inch square brackets with little tolerance. McCoy used an 0.030 inch round gold alloy arch with the pin and tube bracket. This was not so severe, as it did not involve torque. Spencer Atkinson created the universal bracket which employed a light ribbon and a light round wire. Joseph Johnson, in 1930, introduced the twin round wires for the anterior brackets. This mechanism won many converts because of the painless ease of effecting rotations and tipping. It reduced bulk and offered greater resiliency and, thus, longer range of activity.

The physiologists and histologists were interested in tooth movement and cellular activity during the process. Their research has been reviewed in many papers, but it is important that we devote some thought to their work in connection with this subject. Oppenheim[1] offered his paper entitled "Tissue Changes Incident to Tooth Movement" in 1911. He continued his investigations in this field until his last publication in 1944.[3] His convictions from his long studies were that: "Certain damages in bone, cementum, periodontium and pulp are unavoidable, and one must always reckon with them. To reduce these damages, only the most gentle, elastic, intermittent and well-directed forces are to be considered for practice." He demonstrated with sections from animal and human specimens that, in forced tooth movement, osteoblastic activity is stimulated on the pull side and spicules of bone are built up in the direction of the pull. Osteoclasts cut the resting alveolar process into spicules, which are also in the direction of force on the side toward which force is exerted, and there are both bone absorption and bone formation. If the force is sufficient to interfere with the circulation by constricting the periodontal membrane, tissue

This thesis, which was given as a partial fulfillment of the requirements for certification by the American Board of Orthodontics, is being published with the consent and the recommendation of the Board, but it should be understood that it does not necessarily represent or express the opinion of the Board.

activity is slowed and some very undesirable results are produced at this point, including movement of the apex of the root in the opposite direction to the crown.

It is difficult for the orthodontist to understand that the appliance should not move the tooth, but only set up cellular activity in the tissues which carry the tooth in the direction of force.

Sicher[8] explains: "Bone tissue grows only by apposition. Interstitial growth of bone does not exist. The growth by apposition may be on any surface, outer or inner, of a bone." When a tooth is moved, the void left in the path of the moving tooth is filled in by osteoblastic activity from the surface of the exposed bone adjacent to the void. The activity follows a near-physiologic process only when light (intermittent) forces are used.

Harold Ray[12] offers a graphic illustration of the histologic processes involved in bone, periodontium, and connective tissues accompanying tooth movement by force. He supports Oppenheim's viewpoint that "Only the weakest elastic forces, intermittently applied, and interrupted by periods of rest, are permissible in practice. The periodontium, composed of the periodontal membrane, the alveolar bone proper, and the cementum of the tooth, is the biologic unit with which the movement of teeth, either physiologically or mechanically, is concerned. The crucial tissue of the group is, of course, the periodontal membrane, which, being composed of fibrous connective tissue, has the ability within itself to elaborate cells which produce cementum, on the one hand, and can produce bone and resorb bone, on the other. This can only be accomplished properly in the presence of an adequate blood supply and with a lapse of time, during which the adjustment can operate."

Orban,[5] who worked with Gottlieb on experiments to test the postulates of Oppenheim in 1936, disagreed with his premise that human tissue in the periodontium reacts differently from animal tissue. He also disagreed with the contention that only light, intermittent force should be used. He states: "It is irrelevant whether an intermittent or a continuous pressure is exerted. The bone, and especially the connective tissue covering the bone, have but two biologic functions: osteoclastic resorption and osteoclastic deposition. As long as the connective tissue is vital, it will accomplish its task in the same manner. The action of force may be only of such nature that it does not destroy the vitality of the periodontal connective tissue." Schwartz[9] found 20 grams per square centimeter of surface to be the maximum for this force, it being equivalent to the average capillary blood pressure. Orban further states: "It is furthermore irrelevant whether we use an outer or inner arch, or whether the force is transmitted by ligature or spring to the tooth, and thereby the connective tissue. If the force moving a tooth is intermittent, periods of active movement succeed periods of rest. The bone newly formed during rest must first be resorbed. Thus the function of the connective tissue is impeded by the intermittent stress, and additional burden is imposed upon it." Other investigators, physiologists, biologists, and histologists, such as Hellman,[6] LeRoy

Johnson, Appleton, and Rittershofer[7] and Gottlieb, shared this general concept and opinion. No one, to my knowledge, has conducted an investigation with contrary conclusions.

In spite of this mass of material, information, and advice, many of us still continue to use heavy-gauge wires, with their consequential severe, abrupt stresses, in our treatment.

In view of the research material and our clinical observations as evidence, I believed that it would be desirable to reduce the abrupt action of square or rectangular arch wires in their brackets by splitting or laminating them for tooth movement and to use the heavy arches only for stability in anchorage, final arch form, and torque. The edgewise arch of 0.022 by 0.028 inch was supplanted by the split or double edgewise 0.011 by 0.028 (Fig. 1). This arch, in its formation and use, is held together by two rectangular tubes of 0.022 by 0.028 inch, to which are soldered hooks for intermaxillary rubbers. The arch has good lateral strength for arch form and resiliency for rotation, anterior tipping, and second order bends in the posterior region. It also can be used

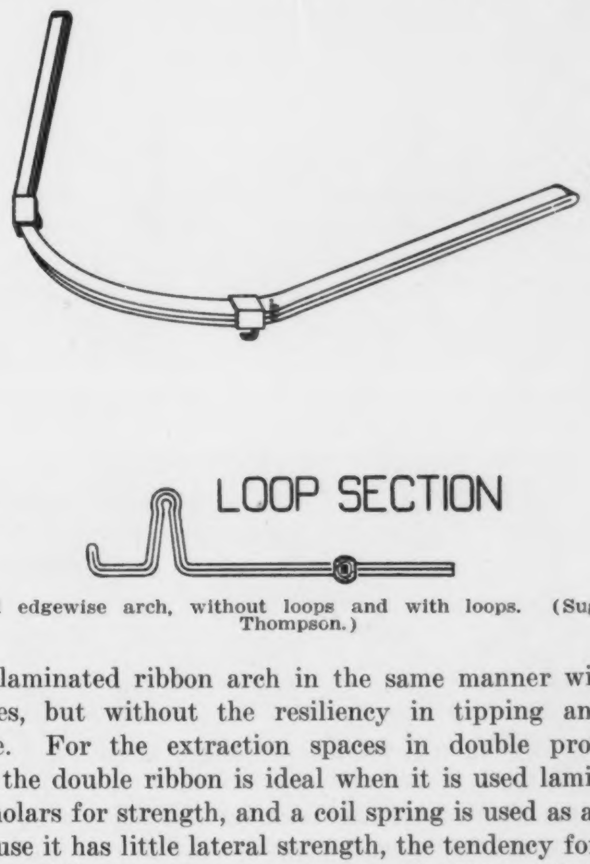


Fig. 1.—Laminated edgewise arch, without loops and with loops. (Suggested by Dr. W. Thompson.)

as a double or laminated ribbon arch in the same manner with two 0.011 by 0.022 inch wires, but without the resiliency in tipping and with reduced expansion force. For the extraction spaces in double protrusions or discrepancy cases, the double ribbon is ideal when it is used laminated only from the cuspids to molars for strength, and a coil spring is used as a retracting force (Fig. 2). Because it has little lateral strength, the tendency for molar rotations mesially as the cuspids are retracted is overcome by lingual light rubbers which are employed from lingual hooks on the cuspid, premolar, and molar (Fig. 3). This force balances the rotation force on the teeth anterior and posterior to the space, and can be easily controlled by selection of the proper sized elastic.

The arch wires are easily seated in the brackets without distortion and with long-range activity. Fig. 4 shows the application of the arch to a lower first premolar extraction case. An inverted V bend is made between the cuspid and premolar for root movement. Second order and offset bends are made for the molars. These bends are easily made with the edgewise arch bending pliers with 0.022 inch square slot. Torque is then placed in laminated areas. To activate

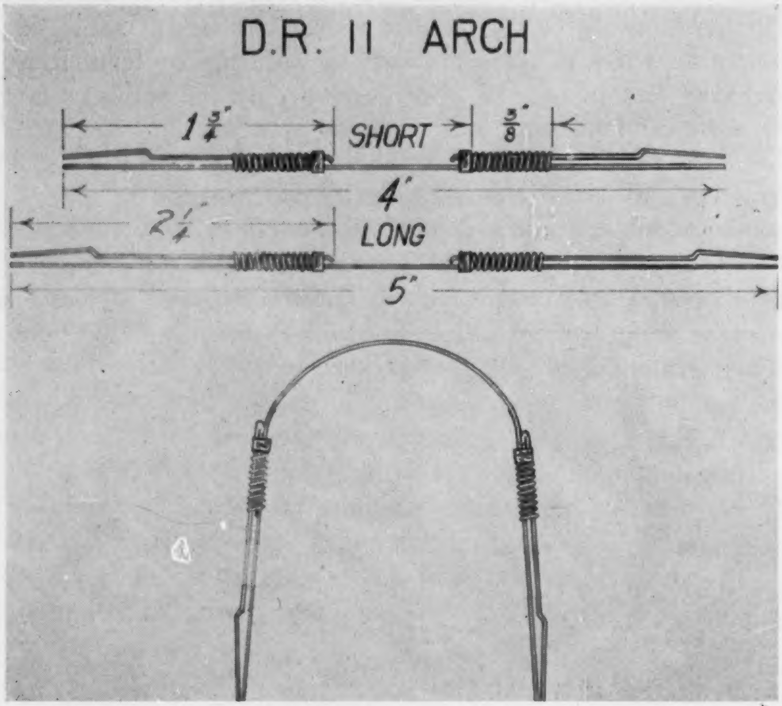


Fig. 2.—Ribbon arches; dimensions; formed arches.

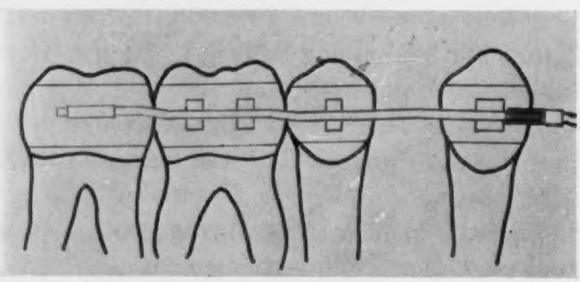


Fig. 3.—First premolar extraction, buccal view.

the coil spring, the tiny round tube is moved distally, compressing it against the bracket; the outer arch is bent buccally, cut shorter, and bent over to the arch to form a stop. The anterior teeth are not banded until retraction of the cuspid is nearly complete. After this is done and the anterior alignment is completed, the case is ready for lower anterior retraction, which is accomplished by cutting the inner arch midway between the molar and second premolar,

bending the free end into a hook lingually and tying it back on both sides or, routinely, the lower twin section may be placed and Class III anchorage employed for three weeks. This is followed by the stabilizing arch of 0.021 by 0.028 inch.

For the space-closing operation, the laminated buccal sections also may be used edgewise to take advantage of greater resilience in bracket engagement and greater lateral strength at the sacrifice of strength in resistance to occlusal stress which the arch possesses when split vertically and used ribbonwise. To form the D.E. 11, the buccal sections of the D.R. 11 are twisted one half-turn distal to the lateral incisor on each side. The anterior portion will thus be a ribbon.

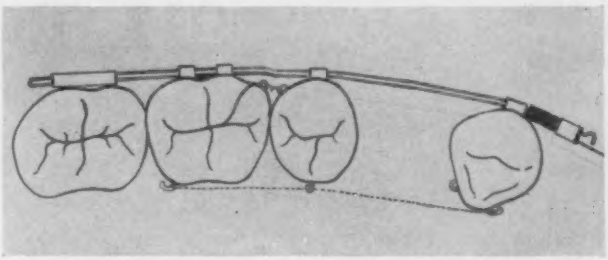


Fig. 4.—First premolar extraction, occlusal view.

The upper arch (Fig. 6) is banded in the same manner, except that a plate is used for support, and 0.021 by 0.028 inch spring wires are used against the mesiolingual surfaces of the teeth anterior to the space to control rotation in distal movement. As the upper precedes the lower, it may be stabilized, reinforced by cervical gear, and Class III rubbers applied to the lower hooks which are found just mesial to the tiny tubes, or to the lower twin section hooks in secondary arch.

This mechanism is particularly well adapted for second premolar extraction cases (Fig. 5). We band the lower lateral incisors and first premolars, and omit the cuspids. The arch is used in the same manner, with the coil spring against the first premolars and the hook on their lingual surfaces. After complete retraction and paralleling of roots, the cuspid is banded, and we may go directly to the lower twin section.

For retraction of the upper teeth to occlusal relation, the arch is removed and an upper sliding twin section is applied (Fig. 7). This is done to reduce treatment time, to allow freer action in distal movement, and to relieve strain on the lower stabilizer arch during the Class III mechanics stage of treatment. I have found no appliance which lends itself more efficiently to this phase of orthodontic treatment and, although the original double ribbon can be used, it is time-saving and better treatment to make this change, which involves so little effort for a more rewarding result.

After posterior occlusal relation is established and anterior teeth are banded and retracted, the finishing arch of 0.021 by 0.028 inch is placed; anterior torque, which is so essential to a beautiful, harmonious dentition, is incorporated; and after several months the bands are removed.

It is most gratifying to go through the so-called "awkward stage" with the laminated arches with such ease and freedom from patient discomfort. Adjustments are few, and simple to perform. Roots line up parallel with no

Fig. 5.

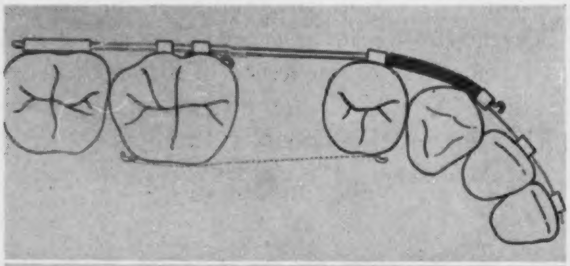


Fig. 6.

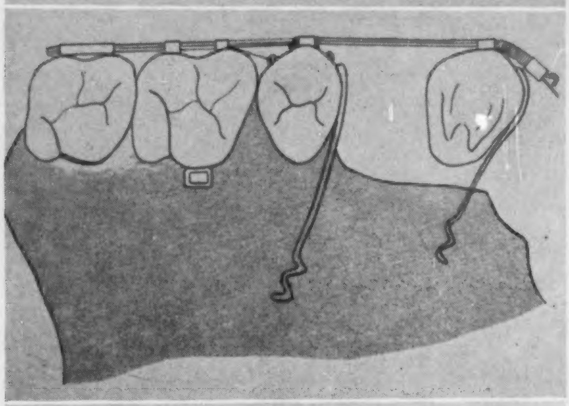


Fig. 7.

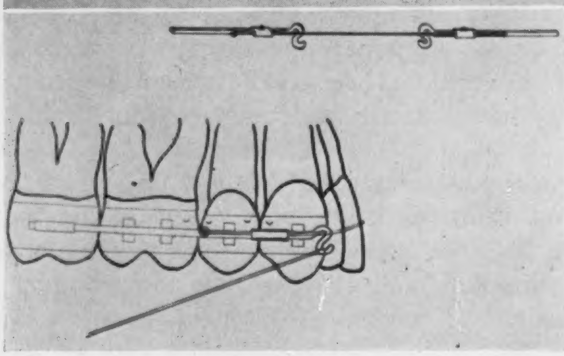


Fig. 5.—Second premolar extraction, occlusal view.
Fig. 6.—Upper plate, occlusal view.
Fig. 7.—Maxillary arch after space closure. Sliding twin section.

effort, bracket engagement is accomplished without instrumentation, prefabricated arches are fitted with chair-time conservation and without soldering operations, and there is a definite feeling of a closer approach to physiologic tooth movement.

Steiner,[13] in his research article entitled "Power Storage and Delivery in Orthodontic Appliances," states:

> A square face, such as 022 × 022 divided horizontally, becomes two rectangular faces each 011 × 022, the 011 dimension being vertical and the 022 being horizontal.

Each of these rectangles has a deflection factor of eight times the deflection of the square. The deflection of the combination of the two would be one half of each and would, therefore, produce a deflection factor of four.

In this direction, then, a given amount of power can be distributed as force over four times the distance of that of a square wire, and twice as much force can be distributed through eight times the distance.

A square wire divided vertically excels in strength, stability and resistance to distortion, while a square wire divided horizontally excells in elasticity and power storage.

Dr. William Thompson of Pittsburgh has demonstrated that these arches also may be used laminated edgewise, with Bull loops incorporated for extraction cases. Those who employ the loops in their extraction technique may enjoy using the arches in this manner. It is startling to discover how far the loop can be opened and still return to a closed position.

I experimented with laminated arches for several years before publishing the material which evolved. Since that time, refinements and improvements have been made in design and application, and a number of orthodontists in various sections of the country have become interested and have contributed innovations in working out their own techniques. These contribute greatly to the adaptation to our treatment of this instrumental principle in mechanics, which I believe to be fundamentally sound but in its infancy of application to our field.

REFERENCES

1. Oppenheim, Albin: Tissue Changes Incident to Tooth Movement, Am. Orthodontist 3: 56-67, 113-132, 1911-1912.
2. Oppenheim, Albin: Human Tissue Response to Orthodontic Intervention of Short and Long Duration, Am. J. Orthodontics and Oral Surg. 28: 283-301, 1942.
3. Oppenheim, Albin: A Possibility of Physiologic Tooth Movement, Am. J. Orthodontics and Oral Surg. 30: 277-368, 1944.
4. Oppenheim, Albin: Orthodontic Therapy and Reality, Angle Orthodontist 5: 159-211, 233-270, 1935.
5. Orban, Balint: Biologic Problems in Orthodontia, J. Am. Dent. A. 23: 1849-1870, 1936.
6. Hellman, M.: Physiologic Treatment, Dental Cosmos 72: 578, 1930.
7. Johnson, A. LeRoy, Appleton, J. L., Jr., and Rittershofer, L. S.: Tissue Changes Involved in Tooth Movement, Int. J. Orthodontia 12: 889, 1926.
8. Sicher, H.: The Growth of the Mandible, Tr. American Association of Orthodontists, 1947, pp. 123-128.
9. Schwartz, A. M.: Tissue Changes Incidental to Tooth Movement, Int. J. Orthodontia 18: 331, 1932.
10. Carey, C. W.: A Light, Resilient Arch Mechanism for Extensive Space Closure, Angle Orthodontist 21: 67-75, 1951.
11. Carey, C. W.: Principles and Mechanics of Treatment With the Sliding Twin Section Mechanism, Am. J. Orthodontics and Oral Surg. 33: 1-20, 1947.
12. Ray, Harold: Personal communications.
13. Steiner, Cecil C.: Power Storage and Delivery in Orthodontic Appliances, Am. J. Orthodontics 39: 859-880, 1953.

616 University Ave.

AUTONOMIC ORTHODONTICS

A Case Report

Edward I. Silver, D.M.D., Boston, Mass.

THE title of this case report is "Autonomic Orthodontics." Although many of you may be familiar with the separate words in my title and perhaps even with the process which they attempt to describe, I should like to take a minute to explain exactly what I mean by "autonomic orthodontic correction." The word *autonomic,* as given in Stedman's *Medical Dictionary,* means self-controlling and spontaneous. I use it in this case to emphasize that aspect of orthodontic treatment with which this report deals, in which the correction is natural and subsequent to serial extractions.

This child was first seen when she was 3 years of age. She had most of the usual childhood diseases, and sucked her thumbs only within the first three months. The mother was diabetic; the child first showed sugar at the age of 6 and was taking insulin. Her skeletal structure was small and narrow throughout for her age. Examination of occlusion indicated a Class II tendency with narrow arches.

The Bogue index, indicating the width of the palate, was 26 mm. at the gingival border of the upper second deciduous molars. Deciduous anterior teeth were crowded and overlapping. Observation was decided upon with the idea of watching this child at regular intervals to determine the direction of growth and development.

At age 8 there was extreme crowding. The ectopic eruption of the lower lateral incisors caused the deciduous canines to be lost prematurely, resulting in more favorable alignment of the lower incisors.

At that time, after measurements from the x-ray films were made of the unerupted teeth and related to the space available, I felt that we might consider it advisable to extract the upper deciduous canines to correspond with the lower ones and follow a plan of serial extractions.

About a year later, when the patient was 9 years old, I next advised the extraction of the four first deciduous molars in order to facilitate the eruption of the permanent canines.

At age 10, the remaining four second deciduous molars were removed.

Now the patient had no deciduous teeth in her mouth and the first premolars were about to erupt.

Within three months of that time, the four first premolars, which were just erupting through the gingiva, were ordered removed.

Fig. 1.

Fig. 2.

Fig. 1.—Top x-ray films show results of ectopic eruption of lower deciduous lateral incisor with insufficient space for canines. Bottom section shows x-ray films after upper deciduous canines were removed, which allowed for alignment of all anterior teeth. At this time it was decided to follow a plan of serial extractions.

Fig. 2.—Bottom x-ray films of case following the extractions of all deciduous teeth and the four first premolars. Top x-ray films show the lower canines in good position and the upper canines ready to erupt with ample space to receive them.

Fig. 3.—Left and right lateral jaw x-ray films taken at the age of 12 years and 6 months show excellent position of roots of canines and second premolars.

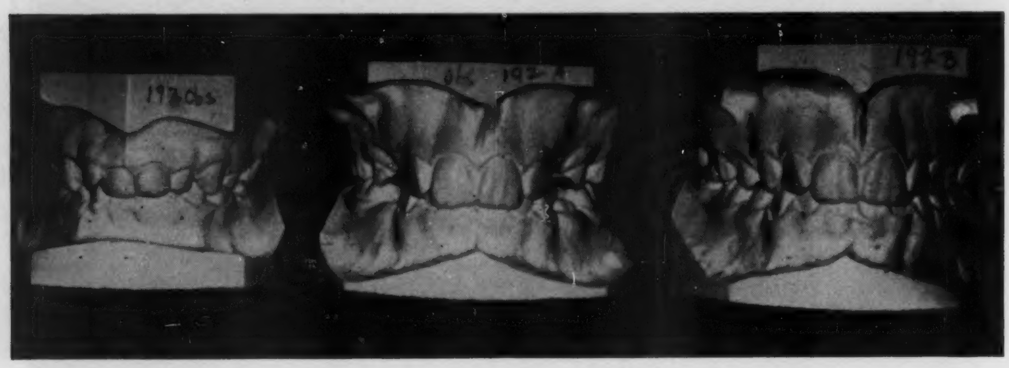


Fig. 4.—Front view of models taken at ages 3, 10, and 12½ years, showing the progress toward a very satisfactory occlusion.

Fig. 5.

Fig. 6.

Fig. 5.—Right side of models showing more favorable anterior-posterior relationship in the latest model.

Fig. 6.—Left side of models showing progress with good relationship except for second premolars which have not fully erupted as yet.

Fig. 7.—Occlusal view showing good arch form with the right amount of space to accommodate the number of teeth present.

Fig. 8.—Front view, intraoral Kodachrome showing good health of supporting tissues, upright position of anterior teeth, satisfactory overbite, overjet, and alignment.

Fig. 9.

Fig. 10.

Fig. 9.—Right side Kodachrome showing good axial inclination and good interdigitation of teeth.

Fig. 10.—Left side Kodachrome showing favorable and efficient occlusion.

Our results following this procedure developed a favorable Class I relationship, good arch form, no crowding, no spaces, upright position of incisors, good axial inclination of posterior teeth, and an overbite and overjet within normal range. We also have an esthetic and stable product, which is most important.

Fig. 11.

Fig. 12.

Fig. 11.—Front full face view. Well-balanced face.

Fig. 12.—Side-face view. Good profile, well-proportioned development. Certainly the face does not indicate the loss of dental units.

It seems to me that this patient has been served well.

Decision must be made early as to which case to select for autonomic correction. First of all, we must feel that there has been an apparent reduction of arch length. Furthermore, we also must be sufficiently satisfied that the case would not respond to ideal treatment whereby all units were going to be kept in place.

If our decision is correct, we have many advantages to gain by this procedure:

1. Minimum disturbance of dental structures.
2. Minimum inconvenience in time and expense to the patient.
3. If subsequent mechanical therapy is needed, it would be reduced to a minimum with less chance for relapse.

This report illustrates an opportunity for rendering a service for a practical end result without appliance therapy.

80 Boylston St.

SUGGESTIONS TO AUTHORS OF ARTICLES TO BE SUBMITTED TO THE AMERICAN JOURNAL OF ORTHODONTICS

Manuscripts

1. An article should not be submitted simultaneously to two publications.

2. Original manuscript only is published in the AMERICAN JOURNAL OF ORTHODONTICS (unless by special order of the editorial board).

3. Usually when a paper is read before a formal society, it becomes the property of that group or organization.

4. Each manuscript must be carefully typed on standard 8½ by 11 inch paper (no onion skin, please). Double spacing and wide margins (at least 1 inch) are essential. Carbon copies should not be submitted for publication.

5. The name and address of the author must appear on each manuscript.

6. Formal *college* degrees should follow the name of the author.

7. If the paper was presented before a society, a footnote giving full details should be included at the bottom of the first page.

8. If the material presented is based on work done in a college or institutional laboratory, this information may be given in a footnote.

9. Manuscript pages should be numbered in sequence.

10. References should be typed on a separate sheet (or sheets) of paper, rather than as footnotes throughout the body of the manuscript. They should follow the customary JOURNAL style:

Journal articles:

1. Doe, John: Title of Article, name of journal **41**: 504-520, 1955 (volume number, page numbers, year).

Books:

1. Doe, John: Practical Orthodontics, ed. 3, St. Louis, 1955, The C. V. Mosby Company, pp. 74-77.

11. Legends should be typed together on a separate sheet of paper, rather than on the back of or below each illustration or scattered throughout the body of the manuscript.

12. Tables that are too long to put on a standard sheet of typewriter paper should be continued on another page. Several sheets should not be taped together to accommodate a long table.

13. Tables or tabulations are not to be numbered as if included in sequence of illustrations, but should be numbered consecutively, and each should be given a heading.

14. The title of an article should be descriptive but brief. The author should not attempt to summarize his paper in the title.

15. In an article of some length, it is well to employ subheads (center heads). Further subdivision may be indicated by italic side heads.

16. A summary of the findings is often desirable at the close of a paper.

17. Material from other published works cannot be quoted without permission of both the original author and the publisher. The source of such quoted material must be supplied in the manuscript.

18. In quoting material from published sources, the author should be careful to place quotation marks at both the beginning and the end of each quotation.

19. Excessive sentimentality and attempts at "cleverness" should be avoided. While these elements may liven an oral presentation before a society, in print they tend to detract from the traditionally fine, scientific quality of the AMERICAN JOURNAL OF ORTHODONTICS.

20. The spelling of all proper names should be checked carefully.

21. The use of particular trade names of products and appliances is to be avoided when possible. When trade names are used, they must be capitalized.

22. Standard abbreviations may be used; obscure and unnecessary abbreviations should be avoided.

23. Adjectives should not be used as nouns ("the lingual," "the centrals," etc.).

24. Nomenclature adopted officially by the American Dental Association and the AMERICAN JOURNAL OF ORTHODONTICS should be used; otherwise, the nomenclature may prejudice acceptance of the manuscript.

25. Case reports should be written out in full (but not overillustrated).

26. Verbosity and profusion should be avoided.

27. The proper place for each illustration should be indicated either in the text of the article or in the margin of the manuscript.

28. Authors should answer all questions that appear in the margins of galley proof.

29. When returning corrected proof, authors should not return original illustrations.

Style

30. Editorial alteration, such as changes in spelling and employment of certain terms in preference to others, simply indicates adherence to a certain "style" as is the custom in publication offices. The standard dictionary is consulted for general terms and a medical dictionary for general anatomic terms. The shorter, simpler terms are given preference ("pathologic" instead of "pathological"). Well-established English plurals are preferred to Latin plurals ("curriculums" instead of "curricula"). Unnecessary capitalization and hyphenation are to be avoided. "Orthodontics," not "orthodontia," is official. When naming organizations, for instance, the A.A.O. is the American Association of Orthodontists (not "Orthodontics").

Illustrations

31. Illustrations should be limited to what is actually necessary. The expense of illustrations for an orthodontic manuscript is limited to $100.00, and for a case report to $50.00. This limitation is by virtue of a contract between the American Association of Orthodontists and the publishers. In the event illustration expense exceeds this figure, the excess is paid by either the author, the society before which the paper was read, or some other source. (Expense is estimated on the basis of cost per square inch, rather than per illustration.) Expense notwithstanding, *overillustration* is adverse to most scientific manuscript.

32. Orthodontic manuscript, by its very nature, lends itself to overillustration. Publishers do not publish infinite numbers of lantern slides that are routinely used by orthodontic essayists when speaking before meetings.

33. Illustrations should be carefully numbered and, in the case of photomicrographs and other illustrations in which there might be confusion, some indication should be made as to which is the top of the figure.

34. If illustrations are mounted by the author, this should be done with art corners which permit easy and harmless removal of the illustrations. Illustrations should not be mounted on heavy cardboard and they should *never* be fastened down with Scotch tape or staples. Paper clips should *never* be used to attach photographs.

35. Line drawings should be made on slick white paper with undiluted India ink. For good reduction, lines should not be drawn too finely or too close together.

36. For halftone illustrations (photomicrographs, roentgenograms, photographs of patients and casts, etc.) glossy black prints are preferred to photographs on rough or dull-surface papers.

37. Authors must obtain permission to use illustrations published previously, by contacting both the author of the work and the publisher of the journal or book in which such illustrations appeared.

38. When it is necessary that an adult patient's eyes appear in a photograph submitted for publication, the author must secure written permission from the patient. A notation to the effect that permission has been obtained should be included with the manuscript for the guidance of the publisher.

39. When a manuscript containing illustrations is being mailed, a piece of heavy cardboard should be used to keep illustrations from damage.

40. Illustrations should be mailed with the manuscript and not in a separate package.

41. Photomicrographs should show only the necessary portion of the field, or cut-off marks should indicate that portion. (The editor considers it undesirable to reduce photomicrographs, as the magnification is presumed to be significant.)

42. Chart paper should have a background of blue lines if it is desired that the background be lost; black lines if the background is to be retained. Lines of orange, green, etc., appear broken on reproduction.

Department of Orthodontic Abstracts and Reviews

Edited by
Dr. J. A. Salzmann, New York City

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Facial Growth in Man, Studied With the Aid of Metallic Implants. By Arne Björk, *Acta odontol. scandinav.* **13**: 9-34, June, 1955 (a condensation).

The brain and the visual organs attain practically fully developed size before puberty. Growth of the face is more intimately related to the growth of the body as a whole and, therefore, continues to a considerable extent during adolescence. The midfacial structure and nasal cavity grow at a rate commensurate with the need for increased oxygen, whereas the jaws develop at a comparatively high rate to keep up with the increase in metabolism, which continues up to adult age.

From a functional point of view, the cranial base forms the partition between the brain and the facial structure. Accordingly, the internal and external cranial bases must develop at widely different rates in order to accommodate the different development of the brain and the face. Expansion of the brain case during childhood is thus followed by a period of formative development during adolescence in which the cranial base continues to undergo a considerable change.

During the formative development of the cranial base and the brain case, a lowering of the two medial and the posterior cranial fossae occurs in relation to the anterior one. As an effect of this differential growth of the cranial base, the glenoid fossa undergoes a rearward and downward displacement in the cranium. It is evident, therefore, that the growth of the cranial base will exercise a marked influence on the jaw position and on the occlusion of the teeth. The displacement of the temporal bone within the cranial structure with growth (and hence of the temporomandibular joint) varies in extent from case to case.

Vertical and horizontal growth of the mandibule varies with the direction of the growth at the condyle. The vertical component of the growth of the mandibular condyle and the lowering of the medial cranial fossa (and hence of the temporal bone) determine the extent to which the mandible will be lowered in the facial pattern.

The dorsal displacement of the temporal bone and the sagittal growth component of the mandibular condyle are the growth factors which together determine the longitudinal development of the lower face. In most cases these factors counteract each other.

The lowering and extension of the maxilla in the facial pattern are effected by sutural growth, accompanied by a simultaneous periosteal growth of the alveolar arches in height, length, and width. The growth of the bones forming the midfacial structure and the maxilla is associated with the growth and development of both the cranial base and the mandible.

The formative growth of the brain case may be regarded as taking place with the anterior part as relatively fixed in the cranial structure. Analysis of

the general growth pattern of the cranium as a whole may therefore be carried out with reasonable accuracy in the sagittal and vertical directions from a line joining nasion with sella and employing the center of the sella as a fixed landmark, in accordance with well-known x-ray cephalometric procedure.

Modern x-ray technique, nevertheless, is unable to reveal the mechanism governing the growth of the individual bone elements in the facial skeleton. The growth of each separate bone, such as the mandible or the maxilla, is bound up with a change in form which, to a greater or lesser degree, embraces all bone surfaces. This development is effected by periosteal bone growth and through resorption. Hence, it is not possible to use x-ray methods for analyzing the growth mechanism of individual bones in human beings on the basis of comparisons from the external bone contours.

The method used by Björk in this study is based on the use of metallic implants, three or four in each jaw. These x-ray indicators remain in position, serving as reference points with the aid of which the x-ray plates may be orientated so that the growth pattern of each jaw may be analyzed.

A local anesthetic is applied to the places where indicator pins are to be located. The assistant drives home the pin with a smart tap of a lead mallet.

In the cases discussed in the article, the indicators were located in the right side of each jaw, the side close to the film. They were placed in the alveolar arch, level with the apical third of the roots. X-ray exposures were made with the patient's head oriented in a cephalostat. Once the growth at the symphysis is completed, during the first year of life, an increase in the width of the corpus and alveolar arch of the mandible takes place by periosteal bone formation accompanied by a corresponding resorption at the inner surfaces. This periosteal growth varies considerably in extent with different persons. The position of the indicators, which are embedded in the jawbone, is not affected in the transverse plane by this growth. In other words, conditions of projection remain unchanged.

In the maxilla, the growth in width is partly of a similar nature, but the possibility does exist of a transverse widening between the two halves of the maxilla due to growth at the sagittal suture. This would result in the indicators being brought closer to the film. This is of minor importance, however.

It has been found that under certain conditions the indicators may alter their position in the jaws. The chief reason for this seems to be that the pins do not enter the bone correctly or that they happen to be placed in the eruption path of the teeth and get carried along by them. It also has been found that, due to the action of resorption at the nasal floor, the indicators may finish up in the nasal cavity.

INDIVIDUAL DEVELOPMENT

CASE 1.—The first of five cases of growth pattern to be described concerns a boy with harmonious facial structure and normal dental occlusion.

Facial Growth.—There is a pronounced vertical growth of the facial structure, resulting in a marked lowering of the mandible in the facial pattern. The protrusion of the jaws in the facial build remains unaltered. The prognathy angles suffer a reduction owing to sutural growth in length of the anterior cranial fossa.

It may be concluded that the lowering of the maxilla is a parallel displacement, despite the fact that the lowering of the nasal floor is greater at the than at the rear. It may be inferred from this that the change in position of the maxilla due to growth cannot be determined from changes in the inclination of the nasal floor.

In the mandible, the lowering of the indicators is greatest at the posterior end of the jaws. This growth pattern indicates that the lower jaw has undergone a marked rotation, despite the fact that the inferior countour of the mandible is lowered nearly parallel in the face.

Mandible.—The longitudinal growth of the mandible is confined entirely to the condylar head, which is fully in accordance with present-day concept. Hence, there has been no increment in length at the chin region in this case. In other aspects, the growth pattern deviates in several ways from the current conception of mandibular growth. In this case, the condylar growth is directed upward and to some extent forward. According to the anterior part of the cranial base, the growth of the temporomandibular joint has the effect of lowering the mandible and, at the same time, retracting it somewhat. The lowering of the mandible in the face is therefore considerably greater dorsally than frontally. However, the rotation of the mandible is accompanied by a marked resorption at the lower margin in the angulus region. As a result of this resorption, the inclination of the mandibular base line remains virtually unchanged in the face during the growth period, despite the mandibular rotation.

The periosteal growth at the posterior border of the ramus is very slight, and there is no appreciable resorption at the anterior border. This growth pattern must be viewed in relation to the condylar growth direction.

Maxilla.—Growth occurs dorsally and there is no frontal growth increment. The upper jaw is moved forward in the face due to growth of the suture toward the palatine bone, while a simultaneous dorsal elongation of the alveolar arch is brought about by a periosteal deposition of bone on the maxillary tuberosity.

The sutural lowering of the maxilla increases the height of the frontal process. The frontomaxillary suture cannot be discerned on the x-ray film, but the increase in height may be estimated from the nasofrontal suture.

The sutural lowering of the maxilla is accompanied by a periosteal deposition of bone on the floor of the orbit so that the lowering of the latter in the face is less.

On the other hand, the lowering of the nasal floor in the face exceeds the sutural lowering of the maxilla. In other words, the nasal floor is lowered appreciably by the action of resorption and by periosteal bone deposit on the hard palate. In this particular case the process of resorption is more pronounced in the frontal than in the dorsal region, which results in the altered inclination of the nasal line referred to above.

Tooth Eruption.—The path of eruption of the teeth in this case is essentially at a right angle to the plane of occlusion.

Case 2.—The next case of growth analysis described by Björk concerns a girl with a malocclusion characterized by mandibular overjet.

Facial Growth.—The mandible protrudes considerably in relation to the maxilla. The growth development of the facial structure is predominantly sagittal. The vertical increment is negligible. As the longitudinal growth of the mandible is very large in proportion, the sagittal jaw relation is altered with development. Clivus has grown in length in proportion to the lowering and backward movement of the articular tuberculum. The condylar head, however, has moved forward against the articular eminence. This indicates a ventral displacement of the mandible, probably related to a marked increment of the overbite with the development.

The maxilla has been lowered and transported forward by sutural growth without suffering any rotation. In this case the direction of sutural growth, in contrast to that of the first case, is chiefly in the sagittal plane.

The positional change of the mandible with growth is also found to have occurred chiefly in a sagittal direction and is considerably greater in the mandible than in the maxilla. The displacement of the indicators also shows that the vertical lowering has been greatest for those which were located farthest back in the jaw and that a certain rotation of the lower jaw has taken place, although the latter movement is not so marked as in the first case.

Mandible.—Examination of the growth increment of the individual jaws shows that the condylar growth has occurred rearward, in the longitudinal direction of the jaw. Consequently, the jaw has increased in length, whereas there has been no appreciable increase in height. The direction of growth in the facial diagram is 45 degrees rearward. Here we find the growth changes in the mandibular outlines associated with condylar growth different in nature from those observed in the first case. Appreciable periosteal growth has taken place at the posterior border of the ramus, accompanied by a marked resorption of its frontal border. It is also found that a deposition of bone, associated with the condylar direction of growth, has taken place on the lower border of the mandible at the gonial angle. This is in contrast with the resorption in that area observed in the previous case. On examining the general growth pattern, one finds that the inclination of the mandibular base line has diminished with growth. The explanation lies in the rotation of the mandible in conjunction with the bone deposition at the angulus region.

Maxilla.—In general, the growth changes which have taken place in the maxilla are in accordance with that in Case 1. However, there is a very marked resorption in length in the anterior nasal spine region. The lowering of the nasal floor by resorption is much more pronounced than in the previous case.

The growth analysis reveals certain significant factors in the interpretation of the vertical growth of the upper facial structure. In some persons the lowering of the maxilla is effected mainly by sutural growth, while in others it is brought about chiefly by periosteal growth increment in the height of the alveolar arch. In the first mentioned case, the increase in the height of the cavity is due mainly to the sutural lowering of the maxilla, whereas in this case it is due mainly to the lowering of the nasal floor through resorption.

Bite Development.—The development of the bite is greatly influenced by functional forces, both dysplastic and compensatory. Case 2 clearly illustrates the influence of compensatory forces. The general growth pattern shows that the mandibular prognathism has increased in relation to the maxilla. This tendency in the development of the face is compensated by a reduction in alveolar prognathy in the mandible and by increased facial inclination of the maxillary incisors. As a result, the alveolar arches change in shape. The anthropologic reference points, the subspinal and the supramental points, corresponding to the apical zones, are thus moved with development.

Tooth Eruption.—The method described above allows the conditions governing tooth eruption to be analyzed with considerable accuracy, which cannot be achieved with ordinary x-ray cephalometric methods. It should be noted that the direction of eruption depends to some degree on functional influences. The eruption of the teeth thus follows a forward path in the maxilla and a rearward path in the mandible, as compared with the vertical eruption in the previous case.

The eruption of the third molars should also be noted. In Case 1, where the resorption at the frontal margin of the ramus is slight, the danger of impaction of the lower third molars appears to be greater than in Case 2, in which the ramal resorption is considerable. The marked resorption at the frontal margin of the ramus and the inadequate vertical growth of the mandible ap-

pear to necessitate a lowering of the tooth germs of the third molars. It may be concluded, therefore, that the mode of eruption of the teeth is associated with the growth pattern of the entire face.

Besides the movement of the tooth germ prior to calcification, two modes of eruption are considered: (1) due to the root formation by which process the tooth is raised from the socket and (2) due to a heightening of the entire tooth together with the socket. In the first case, the erupting force is explained by the mitotic division of the pulp tissue. In the second case, the force may be explained by the mitotic division of the periodontal tissue. This suggests, in contradiction to current belief, that the bone deposition in the socket is a secondary process.

Differentiated proliferation in the various regions of the periodontal membrane explains the variation in eruptive direction and mesial migration of individual teeth in the same manner as the differential growth of the connective tissue in the cranial sutures causes the formative development of the brain case.

The prefunctional phase of the eruption presupposes a resorption of bone tissue in the direction of movement. One may be justified in considering this resorption as much a primary function in tooth eruption as the proliferation of periodontal tissue. Both processes may be governed by biochemical factors similar to those which control the processes of simultaneous resorption and periosteal deposition of bone at the frontal and dorsal ramal margins. From this, it would follow that the eruption of the teeth, at least at the second stage, would be independent of the system of fibers in the periodontal membrane. The influence of external forces on the eruption may be assumed in principle to act in a similar manner as in orthodontic tooth movement.

CASE 3.—The patient is a boy with normal occlusion of his teeth.

Facial Growth.—The growth of the facial structure is pronounced in both sagittal and vertical directions. The direction of growth of the maxilla is 45 degrees forward and downward, accompanied by a slight rotation, as revealed by the displacement of the indicators in the facial growth diagram. Considerable rotation is associated with the growth of the mandible, which has been lowered more dorsally than ventrally.

Mandible.—The condylar growth direction is chiefly vertical, accompanied by appreciable resorption in the angulus region.

Maxilla.—The lowering of the maxilla is due mainly to sutural growth. Increase in the height of the nasal cavity is due almost entirely to sutural growth. Resorption at the nasal floor is insignificant. The orbit has retained its position vertically in the facial diagram due to periosteal growth, in spite of marked sutural lowering of the maxilla.

The bite development is normal and the eruption path of the teeth is vertical to the occlusal plane.

CASE 4.—

Facial Growth.—In this case, the dentition is characterized by aplasia of several teeth (8, 5, 4, +4, 5, 7, 8 and 8, 5, 1—1, 4, 5, 7, 8). The growth of the facial structure is pronounced in both sagittal and vertical directions. It is of particular interest to note that the lowering of the maxilla due to sutural growth has been accompanied by a pronounced rotation. The mandible is also rotated.

The influence which the growth of the cranial base exerts on the vertical development of the facial structure is evident, as the temporal bone together with the articular fossa is lowered markedly during growth in relation to the line drawn from nasion to sella.

Mandible.—The growth of the mandible differs from that of the previous cases, especially as regards the periosteal bone formation on the lower border of the symphysis, whereas the lower margin of the mandible shows no evidence of change in shape in the angulus region.

Maxilla.—A lowering of the maxilla has occurred, due to the joint action of sutural growth and periosteal bone deposition at the alveolar crest accompanied by a corresponding lowering of the nasal floor by resorption. It should be noted that in this case no deposition of bone has occurred at the floor of the orbit. The infraorbital ridge, therefore, has been lowered in the face.

The bite development is characterized by a relatively marked increase in prognathy of the mandible. The change in sagittal jaw relation due to growth has been compensated in the maxilla by a facial tilting of the incisors. Eruption of the maxillary molars has followed a mesial direction, which in this case may also be regarded as a compensatory effect. The actual cause of this, however, may be the aplasia of the maxillary premolars. The longitudinal growth of the maxillary alveolar arch at the alveolar tuberosity is normal, despite the lack of three molars. In the mandible, tooth eruption is vertical in spite of aplasia of premolars.

CASE 5.—The final case is one of Angle Class II malocclusion.

Facial Growth.—Here the quantitative growth of the face is average as regards both height and length. No longitudinal growth increment of the clivus or any lowering of the medial cranial fossae is discernible. The lowering of the mandible in the facial diagram depends, therefore, entirely on its own growth. The condylar growth in height is very marked, and the mandible is rotated in the way described in the previous case. The direction of growth of the maxilla is forward and downward, with a tendency to rotation.

In Case 3, and especially in Case 4, it is possible to discern a certain rotation of the maxilla. In all the cases reported there is a definite rotation of the mandible, which is least, however, in Case 2, in which the growth has been directed rearward.

Mandible.—The growth of the mandible is essentially vertical, and this growth pattern has been accompanied by resorption in the angulus region.

Examination of the x-ray film will, in many cases, convey some idea of the progress of the mandibular resorption process, which may provide valuable clinical information. If this information is lacking, great care should be exercised in clinical interpretation of the inclination of the mandibular base.

Maxilla.—Sutural lowering of the maxilla has occurred without any appreciable resorption of the nasal floor. The floor of the orbit has been raised by periosteal growth and has not been subjected to any lowering in the face.

The bite is characterized by a retruded position in the facial profile of the mandible in relation to the maxilla. The dentoalveolar structure is normal, without major dysplastic deviations. The bite development appears to continue without any appreciable change in the occlusion.

The eruption of the teeth in the side segments of both jaws follows a mesial direction, probably due to pressure exerted by the erupting molars.

Eruption appears to depend on the rotational tendency of the mandible. It is also influenced by a mechanical factor, such as the pressure from adjacent teeth, and functional forces, such as the pressure of the tongue and lips. Variations of this kind in the conditions governing tooth eruption merit a detailed investigation.

News and Notes

Fifty-Second Annual Meeting of the American Association of Orthodontists

Statler Hotel, Boston, Mass., Sunday, April 29, Through Thursday, May 3, 1956

The committees charged with planning for the above meeting herewith submit a preliminary program. While incomplete, it provides a preview of what is being arranged.

Sunday, April 29

10:00 TO 5:00 P.M.	Registration.
12:00 NOON TO 9:00 P.M.	An exhibit of case reports submitted by some of the diplomates certified at the 1955 examination of the American Board of Orthodontics. (This exhibit also will be on display Monday, Tuesday, and Wednesday from 9:00 A.M. until 9:00 P.M. daily.)

Monday, April 30

8:00 A.M.	Registration.
9:30 A.M.	Invocation.
	Address of Welcome.
	Response.
10:00 A.M.	President's Address. Philip E. Adams, Boston, Massachusetts.
10:30 A.M.	Physical Anthropology. Wilton Krogman, Philadelphia, Pennsylvania.
11:15 A.M.	Orthodontic Treatment Factors in Class II Malocclusions. Alton W. Moore, Seattle, Washington.
12:15 P.M.	Golden Anniversary Luncheon.
2:00 P.M.	Presentation of the Albert H. Ketcham Memorial Award.
2:30 P.M.	The Pediatrician Looks at Orthodontics. Warren R. Sisson, Boston, Massachusetts.
3:15 P.M.	Cleft Palate Therapy Based on the Study of Morphogenesis. Egil Harvold, Oslo, Norway, and Ann Arbor, Michigan.
4:00 P.M.	Varieties of Anomalies in Class II Tooth Relationship. Robert Moyers, Ann Arbor, Michigan.

Get-Acquainted Dinner for Members, Their Ladies, and Guests

6:30 P.M.	Cocktails.
7:30 P.M.	Dinner.

Tuesday, May 1

9:00 A.M.	General Table Clinics (incomplete).

Group

Tuft's Graduate Orthodontic Department (eight tables). H. Margolis, Director.

Arnold Binder	Henry Geim
Harold Brehm	Phillip Gilley
William Carvelli	Raymond Licht
Herbert Davidson	William O'Donnell
Norman Freeman	Theodore Segal

Tuft's Study Club (five tables).
Harvard Dental School (four tables).
New York University (six tables).
Forsyth Dental Infirmary (four tables).
Columbia Study Group (eight tables).
University of Pennsylvania, P. V. Reid, Director.
Columbia University, A. C. Totten, Director.

Individual

Solomon Kessler, Newark, New Jersey.
S. James Krygier, Wilmington, Delaware.
Vincent Marran, Springfield, Massachusetts.
Ernest Mendelhoff, Bridgeport, Connecticut.
Walter Mosmann, Hackensack, New Jersey.
Milton Nager, Jersey City, New Jersey.
Joseph Schacter, Regina, Saskatchewan.
Kenneth Walley, Vancouver, B. C.

11:30 A.M. Business Session.
12:30 P.M. Past Presidents' Luncheon.
2:00 P.M. Prize Essay and Report of Research Section. Herbert Margolis, Chairman.

Wednesday, May 2

Milton Meyers, Lawrence, Massachusetts, Chairman.

9:00 A.M. Limited Attendance Clinics (incomplete).

Marvin Davis, Detroit, Michigan.	The Esthetics of the Human Face.
Irving Glickman, Boston, Massachusetts.	Periodontal Tissue During Orthodontic Movement.
Robert Hedges, Jenkintown, Pennsylvania.	Simplified Cephalometrics.
L. Bodine Higley, Chapel Hill, North Carolina.	Anchorage.
Ashley Howes, New Rochelle, New York.	Methods of Case Analysis.
V. Everett Hunt, Eureka, California.	The Stock Market.
Herbert Margolis, Boston, Massachusetts.	Auxiliaries in Mechano-Therapy.
Robert Strang, Bridgeport, Connecticut.	The Value of Routine Case Analysis.
Clifford Whitman, Hackensack, New Jersey.	Habits Have Gotten To Be A Habit With Me—1956 Version.
William Wilson, Boston, Massachusetts.	Variations of the Labio-Loop-Lingual Appliance.

12:00 NOON Round-Table Luncheon Discussions (incomplete).

Discussion Leaders	*Topics*
Edwin Lunsford, Miami, Florida.	Labiolingual Treatment.
William Wilson, Boston, Massachusetts.	Labiolingual Treatment.
Len Fairbanks, Inglewood, California.	Twin Wire Treatment.
Edward Silver, Boston, Massachusetts.	Twin Wire Treatment.
Brainerd Swain, Morristown, New Jersey.	Bull Technique.
Arthur Greenstein, New York City, New York.	Tweed Technique.

Ben Herzberg, Chicago, Illinois.	Tweed Technique.
Samuel Lewis, Kalamazoo, Michigan.	Tweed Technique.
Morris Stoner, Indianapolis, Indiana.	Tweed Technique.
Egil Harvold, Oslo, Norway, and Ann Arbor, Michigan.	The Andresen Appliance.
B. F. Dewel, Evanston, Illinois.	Serial Extractions.
Z. Bernard Lloyd, Washington, D. C.	Serial Extractions.
Joseph Jarabak, Hammond, Indiana.	Mixed Dentition.
Allan Brodie, Sr., Chicago, Illinois.	Diagnosis.
Ashley Howes, New Rochelle, New York.	Diagnosis.
Francis Loughlin, New York City, New York.	Diagnosis.
T. M. Graber, Chicago, Illinois.	Office Cephalometric Equipment.
William Downs, Aurora, Illinois.	Clinical Cephalometrics.
L. Bodine Higley, Chapel Hill, North Carolina.	Clinical Cephalometrics.
Herbert Margolis, Boston, Massachusetts.	Clinical Cephalometrics.
Wendell Wylie, San Francisco, California.	Clinical Cephalometrics.
Ernest Johnson, San Francisco, California.	Retention.
Raymond Webster, Providence, Rhode Island.	Retention.

2:45 P.M. Versatility in Appliance Therapy. Donald Osborn, Providence, Rhode Island.

3:30 P.M. Adverse Muscle Forces—Their Diagnostic Significance. W. J. Tulley, London, England.

6:30 P.M. President's Reception and Banquet.

Thursday, May 3

9:00 A.M. Clinical Consideration of Occlusion. J. H. Sillman, New York, New York.

9:45 A.M. The Cinefluorograph in Orthodontics. Herbert Cooper, Lancaster, Pennsylvania.

10:30 A.M. Varieties of Anomalies in Class III Tooth Relationship. Allan Brodie, Sr., Chicago, Illinois.

11:00 A.M. Serial Extractions. Bernard Lloyd, Washington, D. C.

11:45 A.M. Business Session and Adjournment.

1956 Prize Essay Contest, American Association of Orthodontists

Eligibility.—Any member of the American Association of Orthodontists and any person affiliated with a recognized institution in the field of dentistry or associated with it as a teacher, researcher, undergraduate, or graduate student shall be eligible to enter the competition.

Character of Essay.—Each essay submitted must represent an original investigation and contain some new significant material of value to the art and science of orthodontics.

Prize.—A cash prize of $500.00 is offered for the essay judged to be the winner. The committee, however, reserves the right to omit the award if, in its judgment, none of the entries is considered to be worthy. Honorable mention will be awarded to those authors taking second and third places. The first three papers will become the property of the American Association of Orthodontists and will be published. All other essays will be returned.

Specifications.—All essays must be in English, typewritten on 8½ by 11 inch white paper, double spaced with at least 1 inch margins. Each sheet must be numbered and bound or assembled with paper fasteners in a "brief cover" for easy handling. Three complete copies of each essay, including all illustrations, tables, and bibliography, must

be submitted. The name and address of the author must not appear in the essay. For purpose of identification, the author's name, together with a brief biographical sketch which sets forth his or her dental and/or orthodontic training, present activity, and status (practitioner, teacher, student, research worker, etc.) should be typed on a separate sheet of paper and enclosed in a sealed envelope. The envelope should carry the title of the essay.

Presentation.—The author of the winning essay will be invited to present it at the meeting of the American Association of Orthodontists to be held at the Statler Hotel, Boston, Massachusetts, the week of April 29, 1956.

Judges.—The entries will be judged by the Research Committee of the American Association of Orthodontists.

Final Submission Date.—No essay will be considered for this competition unless received in triplicate on or before Jan. 10, 1956, by Dr. Thomas D. Speidel, University of Minnesota, School of Dentistry, Minneapolis 14, Minnesota.

H. I. Margolis, Chairman, Research Committee
American Association of Orthodontists
311 Commonwealth Ave.
Boston 15, Massachusetts

American Association of Orthodontists, 1956 Research Section Meeting

Continuing the policy of recent years, the program will consist of a series of ten-minute research reports which may be presented orally or read by title only. All persons engaged in research are urged to participate in this program, which will be held on April 29 and 30 and May 1 and 2, 1956, in the Statler Hotel, Boston, Massachusetts.

Each participant is asked to prepare a 250-word abstract for publication in the American Journal of Orthodontics. Abstract for publication and the ten-minute oral presentation at the meeting should be carefully prepared to present an adequate description of the import of your investigation.

Forms for use in submitting the title and 250-word abstract of your research will be sent to each dental school orthodontic department and to any individual requesting one. Please send your title and abstract as early as possible, but not later than Jan. 10, 1956, to Dr. J. William Adams, 707 Bankers Trust Bldg., Indianapolis 4, Indiana.

H. I. Margolis, Chairman, Research Committee
American Association of Orthodontists
311 Commonwealth Ave.
Boston 15, Massachusetts

American Board of Orthodontics

The next meeting of the American Board of Orthodontics will be held at the Statler Hotel in Boston, Massachusetts, April 24 through April 28, 1956. Orthodontists who desire to be certified by the Board may obtain application blanks from the secretary, Dr. Wendell L. Wylie, University of California School of Dentistry, The Medical Center, San Francisco 22, California.

Applications for acceptance at the Boston meeting, leading to stipulation of examination requirements for the following year, must be filed before March 1, 1956. To be eligible, an applicant must have been an active member of the American Association of Orthodontists for at least three years.

Northeastern Society of Orthodontists

The autumn meeting of the Northeastern Society of Orthodontists was held at the Hotel Commodore in New York City on Oct. 23, 24, and 25, 1955.

Nearly 550 members and guests registered for the three-day session, which commenced with a cocktail party on Sunday night and closed with table clinics and movies on Tuesday afternoon. A well-rounded program of eight papers by six clinicians was presented between Monday morning, when President Eugene Kelly opened the first scientific session, and Tuesday noon.

The hard-working Executive Committee, under Chairman David Mossberg, exhibited prescience which might easily have been the envy of an astute political campaign organizer in assembling this group of essayists. All had well-organized material, liberally illustrated, and spoke from notes, thus facilitating occasional humorous or explanatory interjections which are so often absent from papers read in manuscript form.

The program follows:

Diseases of the Mouth and Jaws of Interest to Orthodontists. Edward V. Zegarelli.

Orthodontic Diagnosis. Robert W. Donovan.

Some Problems in Analysis of the Mixed Dentition. Robert E. Moyers.

Extraoral Force Therapy. James Jay.

If 'Twere Done When 'Twere Done (or When Is Growth a Factor in Treatment Planning?). Wilton Marion Krogman.

Functional Problems in Orthodontics. Robert W. Donovan.

A Feasible Finishing Procedure for Major Treatment Cases. J. William Adams.

How Standard Are "Standards"? Wilton Marion Krogman.

Several proposed changes in the constitution and by-laws received initial approval. One of these creates the office of historian. Dr. Leuman Waugh, whose authoritative paper on "The American Association of Orthodontists" (AM. J. ORTHODONTICS, February, 1952) reflected his long experience and organizational activity on national and local levels, was appointed pro tem pending final action on this amendment.

The other change establishes the posts of editor and assistant editor and clarifies an ambiguous situation revolving around Dr. Joseph D. Eby, who served in dual capacities as editor of the Society and sectional editor of the JOURNAL for many years until the burden became too heavy and some of these duties were delegated to another member. This change defines the respective duties and responsibilities of each office and will enhance their effective operation. To implement this, and pending final approval of the amendment, Dr. Eby was appointed editor and sectional editor of the JOURNAL.

The Board of Censors submitted the following nominations for action at the annual meeting on May 1, 1956:

President, Oscar Jacobson.
President-Elect, Clifford Glaser.
Vice-President, Walter Bedell.
Secretary-Treasurer, Wilbur J. Prezzano.
Editor and Sectional Editor, Joseph D. Eby.
Assistant Editor, Brainerd F. Swain.
Historian, Leuman M. Waugh.

University of Illinois College of Dentistry

Announcement has been made that a closed-circuit television course in "The Early Treatment of Malocclusion of the Teeth" will be presented by the University of Illinois College of Dentistry on Sunday, Feb. 5, 1956. Enrollment is limited to members of the American Association of Orthodontists.

The course will be given by the staff of the Graduate Orthodontic Department of the University of Illinois under the direction of Dr. Allan G. Brodie, assisted by Drs. Earl W. Renfroe, Abraham Goldstein, and Allan G. Brodie, Jr.

University of Kansas City School of Dentistry

The University of Kansas City School of Dentistry announces that it now offers graduate training with an eighteen-month course in orthodontics, periodontology, and pedodontics.

The graduate courses begin July 1.

First International Congress of Human Genetics

The First International Congress of Human Genetics will be held in Copenhagen, Denmark, Aug. 1-6, 1956. This congress is planned to cover all genetic aspects of normal and pathologic characters in man. Any person interested in the subject of human genetics, and especially of medical genetics, is invited to take part in the congress.

Provisional program and further information are sent on request.

THE SECRETARIATE OF THE FIRST INTERNATIONAL CONGRESS OF HUMAN GENETICS,
THE UNIVERSITY INSTITUTE FOR HUMAN GENETICS, 14, TAGENSVEJ,
COPENHAGEN, N., DENMARK.

Rocky Mountain Society of Orthodontists

The Rocky Mountain Society of Orthodontists held its thirty-fifth annual meeting on Nov. 15, 1955, and, in spite of bad weather, 80 per cent of the membership attended. The following officers were elected for 1956:

President, Richard E. Harshman,, Scotts Bluff, Nebraska.
Vice-President, George E. Ewan, Sheridan, Wyoming.
President-Elect, J. Lyndon Carman, 501 Republic Bldg., Denver, Colorado.
Secretary-Treasurer, Howard L. Wilson, 1107 Republic Bldg., Denver, Colorado.
Editor, Henry F. Hoffman, 223 Physicians Bldg., Boulder, Colorado.
Board Member, Walter K. Appel, 4018 Moore Ave., Cheyenne, Wyoming.

Arkansas State Dental Association

The Arkansas State Dental Association has announced that it has endorsed Dr. W. R. Alstadt, orthodontist of Little Rock, Arkansas, for the office of President-Elect of the American Dental Association. The election will be held Oct. 4, 1956, at Atlantic City, New Jersey.

Columbia University

A course on the principles of occlusion, PD 429, consisting of lectures, seminar conference and group participation, and clinical demonstrations, will be given by Professor Lewis Fox and associates on May 23, 24, and 25, 1956, at Columbia University School of Dental and Oral Surgery.

The fee is $150.00. Registration must be made by March 15, 1956. For further information, write to Postgraduate Division, School of Dental and Oral Surgery, 630 West 168th St., New York 32, New York.

American Institute of Dental Medicine

The Board of Directors of the American Institute of Dental Medicine announces that it will provide case histories from the broad field of dental medicine for the year 1955-56.

Further information may be secured from the secretary, Mrs. C. Novembri, 2240 Channing Way, Berkeley 4, California.

Notes of Interest

Harry G. Barrer, D.D.S., announces the removal of his office to 216 North Sixth St., Reading, Pennsylvania, practice limited to orthodontics.

Frank L. Canedy, D.D.S., announces the association of Clarence O. Nauman, D.D.S., 300 Medical Arts Bldg., Springfield, Missouri, practice limited to orthodontics.

Dan D. Dreiling, D.D.S., announces his location, 607½ North Washington St., Junction City, Kansas, practice limited to orthodontics.

Samuel Goldsman, D.D.S., M.A., announces the removal of his office to 304 Hancock Bldg., Falls and First Sts., Niagara Falls, New York, practice limited to orthodontics.

Samuel Kassal, D.D.S., announces the opening of his office at 97-25 64 Ave., Rego Park, New York, practice limited to orthodontics.

E. C. Lunsford, D.D.S., Miami, Florida, announces that Hernando de Castro, D.D.S., is now associated with him in the practice of orthodontics at 2742 Biscayne Blvd., Miami, Florida.

J. Daniel Subtelny, D.D.S., M.S., has been appointed to the orthodontic department at the Eastman Dental Dispensary in Rochester, New York. A limited private practice in orthodontics will also be conducted at the Eastman Dental Dispensary.

James D. Swift, Jr., D.D.S., announces the opening of his office at 3719 Hall St., Dallas, Texas, practice limited to orthodontics.

OFFICERS OF ORTHODONTIC SOCIETIES

THE AMERICAN JOURNAL OF ORTHODONTICS is the official publication of the American Association of Orthodontists and the following component societies. The editorial board of the AMERICAN JOURNAL OF ORTHODONTICS is composed of a representative of each one of the component societies of the American Association of Orthodontists.

American Association of Orthodontists

President, Philip E. Adams - - - - - - - - - - 170 Marlborough St., Boston, Mass.
President-Elect, A. C. Broussard - - - - - - Maison Blanche Bldg., New Orleans, La.
Vice-President, Stephen Hopkins - - - - - - - 1746 K St., N.W., Washington, D. C.
Secretary-Treasurer, Franklin A. Squires - - - - Medical Centre, White Plains, N. Y.

Central Section of the American Association of Orthodontists

President, Richard A. Smith - - - - - - - - - - 9401 Ridgeway Ave., Evanston, Ill.
Vice-President, Fredrick B. Lehman - - 1126 Merchants Bank Bldg., Cedar Rapids, Iowa
Secretary-Treasurer, William F. Ford - - - - - - - 575 Lincoln Ave., Winnetka, Ill.

Great Lakes Society of Orthodontists

President, Milton R. Culbert - - - - - - - - - - 73 Warren Rd., Toronto, Canada
Secretary, H. I. Miller - - - - - - - - - - 1416 Mott Foundation Bldg., Flint, Mich.
Treasurer, Russell E. Huber - - - - - - - - - 350 Fidelity Bank Bldg., Dayton, Ohio

Middle Atlantic Society of Orthodontists

President, Daniel E. Shehan - - - - - - - - - - Medical Arts Bldg., Baltimore, Md.
Vice-President, Gerard A. Devlin - - - - - - - - - 121 Prospect St., Westfield, N. J.
Secretary-Treasurer, Paul A. Deems - - - - - - - - - 835 Park Ave., Baltimore, Md.

Northeastern Society of Orthodontists

President, Eugene J. Kelly - - - - - - - - - - - 455 W. State St., Trenton, N. J.
Secretary-Treasurer, Wilbur J. Prezzano - - - - - Medical Centre, White Plains, N. Y.

Pacific Coast Society of Orthodontists

President, Arnold E. Stoller - - - - - - - - - Medical Dental Bldg., Seattle, Wash.
Vice-President, Richard M. Railsback - - - - - - 298 Grand Ave., Oakland, Calif.
Secretary-Treasurer, Raymond M. Curtner - - - - 450 Sutter St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, Richard Harshman - - - - - - - - - - - 2402 Broadway, Scotts Bluff, Neb.
Vice-President, George E. Ewan - - - - - - - Bank of Commerce Bldg., Sheridan, Wyo.
Secretary-Treasurer, Howard L. Wilson - - - - - - - - Republic Bldg., Denver, Colo.

Southern Society of Orthodontists

President, William Jarrett - - - Kanawha Banking and Trust Bldg., Charleston, W. Va.
Vice-President, Thad Morrison, Sr. - - - - - - - - 353 Doctors Bldg., Atlanta, Ga.
Secretary-Treasurer, H. K. Terry - - - - - - - - - - 2742 Biscayne Blvd., Miami, Fla.

Southwestern Society of Orthodontists

President, Ott L. Voigt - - - - - - - - - - - - - 4115 Fannin, Houston, Texas
Secretary-Treasurer, Harold S. Born - - - - - - - 908 S. Johnstone, Bartlesville, Okla.

American Board of Orthodontics

President, C. Edward Martinek - - - - - - - - - 661 Fisher Bldg., Detroit 2, Mich.
Vice-President, Ernest L. Johnson - - - - - - 450 Sutter St., San Francisco 8, Calif.
Secretary, Wendell L. Wylie - - - - - - University of California School of Dentistry,
The Medical Center, San Francisco 22, Calif.
Treasurer, Lowrie J. Porter - - - - - - - - - - 41 East 57th St., New York, N. Y.
Director, William R. Humphrey - - - - - - - - - - - Republic Bldg., Denver, Colo.
Director, L. Bodine Higley - - - - University of North Carolina, Chapel Hill, N. C.
Director, Jacob A. Salzmann - - - - - - - - - 654 Madison Ave., New York, N. Y.

A List of the Orthodontic Societies of the World and Their Principal Officers*

Chicago Association of Orthodontists

President, Leonard Grimson - - - - - - - - - - - - 636 Church St., Evanston, Ill.
President-Elect, Joseph R. Jarabak - - - - - - - - - - 504 Broadway, Gary, Ind.
Secretary-Treasurer, G. L. Christopher - - - - - - - - - 9504 S. Hamilton, Chicago, Ill.

Orthodontic Alumni Society of Columbia University

President, Robert C. Sturtevant - - - - - - - - - 88-23 184th St., Jamaica, N. Y.
Vice-President, Richard Pasternak - - - - - - - - 30 W. 59th St., New York, N. Y.
Treasurer, Henry P. Levy - - - - - - - - - - - - 8522 5th Ave., Brooklyn, N. Y.
Secretary, Walter Spengeman - - - - - - - - - - - 30 S. Broadway, Yorkers, N. Y.

Harvard Society of Orthodontists

President, Bernard C. Rogell - - - - - - - - - - - - 6 Pleasant St., Malden, Mass.
Vice-President, Ben Wayburn - - - - - - - - - - - 67 Coddington St., Quincy, Mass.
Secretary, Milton J. Meyers - - - - - - - - - - - 281 Haverhill St., Lawrence, Mass.
Treasurer, Clifford G. Hunt - - - - - - - - - - - 14 Muzzey St., Lexington, Mass.

New York Society for the Study of Orthodontics

President, A. D. Mollin - - - - 260 Middleneck Road, Great Neck, Long Island, N. Y.
Vice-President, Leon M. Gecker - - - - - - - - 305 West 72nd St., New York, N. Y.
Secretary, Nathan Sachs - - - - - - - - 84-75 168th St., Jamaica, Long Island, N. Y.
Treasurer, Irving Lederman - - - - - - - - 45-54 41st St., Long Island City, N. Y.

New York University Orthodontic Society

President, Benjamin Wasseman - - - - - - - - 176 Second Ave., New York, N. Y.
Vice-President, Solomon J. Lurie - - - - - - - - - - 1 Hanson Pl., Brooklyn, N. Y.
Secretary-Treasurer, Benjamin Falk - - - - - - - 2742 Pitkin Ave., Brooklyn, N. Y.

Philadelphia Society of Orthodontists

President, Samuel G. Gilbert - - - - - - - - - - 1930 Chestnut St., Philadelphia, Pa.
Secretary-Treasurer, Warren Bieler - - - - 1208 Medical Arts Bldg., Philadelphia, Pa.
Editor, Richard Stucklen - - - - - - - - - - - 908 Delaware Ave., Wilmington, Del.

*In the January issue of the AMERICAN JOURNAL OF ORTHODONTICS is published each year a list of the orthodontic societies of the world of which the JOURNAL has any record, along with the names and addresses of their principal officers.

The JOURNAL keeps a file for each of these societies and publishes the names that appear in that file as of the date of going to press.

St. Louis Society of Orthodontists

President, Leo B. Lundergan - - - - - - - - - - - 4500 Olive St., St. Louis, Mo.
Vice-President, Carl L. Rister - - - - - - - - University Club Bldg., St. Louis, Mo.
Secretary-Treasurer, Everett W. Bedell - - - - 1504 S. Grand Blvd., St. Louis, Mo.

Orthodontic Section of the Canadian Dental Association

Chairman, L. Lepine - - - - - - - - - - - Medical Arts Bldg., Montreal, Canada
Vice-Chairman, A. R. Winn - - - - - - - - - Medical Arts Bldg., Montreal, Canada
Secretary-Treasurer, J. T. Crouch - - - - - - - 185 St. Clair Ave. West, Toronto, Canada

Orthodontic Club of Toronto

President, J. T. Crouch - - - - - - - - - 185 St. Clair Ave., W., Toronto, Canada
Secretary-Treasurer, R. A. Erickson - - - - - - - 86 Bloor St., W., Toronto, Canada

Washington-Baltimore Society of Orthodontists

President, Carlotta A. Hawley - - - - - - - 915 19th St., N. W., Washington, D. C.
Secretary-Treasurer, Harry S. Galblum - - - - 2025 Eye St., N. W., Washington, D. C.

Foreign Societies

Sociedad Argentina de Ortodoncia

President, Enrique Uhalde - - - - - - - - - - - - Rivadavia 755, Buenos Aires
Vice-President, Jorge A. Bisi - - - - - - - - - - - Paraguay 1480, Buenos Aires
Secretary, José L. Ferrería - - - - - - - - - - - - - Córdoba 850, Buenos Aires
Treasurer, Alberto O. del Intento - - - - - - - Félix Muñoz 2097, Saenz Peña (B.A.)

Australian Society of Orthodontists

President, A. Thornton Taylor - - - - - - - - - - 175 Macquarie St., Sydney
Secretary, Robert Y. Norton - - - - - - - - - - - - St. James Bldg., Sydney
Treasurer, Robert W. Halliday - - - - - - - - - - - 127 Macquarie St., Sydney

Sociedad Brasileira de Ortodoncia

President, Joaquim Cavalcanti - - - - - Praca G. Vargas 2, S. 422, Rio de Janiero
Vice-President, Kant Duarte - - - Rua Manuel de Carvalho, 16-9°, S. 91, Rio de Janiero
Secretary, Virgilio Moozen - - de Oliverira, Av. Rio Branco 311-6°, S. 613, Rio de Janeiro

British Society for the Study of Orthodontics

President, K. E. Pringle - - - - - - - - - - - - - 2 Harley St., W. 1, London
Hon. Treasurer, J. S. Beresford - - - - - - - - - 31 Queen Anne St., W. 1, London
Hon. Secretary, H. L. Leech - - - Royal Dental Hospital, Leicester Sq., W.C. 2, London

Sociedad de Ortodoncia de Chile

President, Augusto Ramírez V. - - - - - - - - - - Traslavina 230, Vina del Mar
Vice-President, Juan Colin M. - - - - - - - - - - Augustinas 715 of 111, Santiago
Secretary, Sergio Troncoso M. - - - - - - - - - - - Providencia 1017, Santiago
Treasurer, Pedro Gandulfo G. - - - - - - - - - - - - Londres No. 63, Santiago

Cuban Association of Orthodontists

President, Federico R. de la Rosa - - - - - - - - - - - San Miguel 409, Habana
Vice-President, Margarita Amézaga - - - - - - - - - - - Virtudes 618, Habana
Secretary, Pablo Vallhonrat - - - - - - - - - - - - 21 No. 362 Vedado, Habana
Treasurer, Yolanda Buch - - - - - - - - - - - - - Edificio L y 23. D-10, Habana

Dutch Society for the Study of Orthodontics

President, J. A. C. Duyzings - - - - - - - - Hamburgerstraat 19, Utrecht, Holland
Vice-President, K. G. Bijlstra - - - - - - - Verl. Hereweg 114, Groningen, Holland
Secretary-Treasurer, C. J. Sindram - - - - - - - - Kenaupark 27, Haarlem, Holland
Commissars, S. W. Weisfelt - - - - - - - - - - - - Emmalaan 2, Utrecht, Holland
W. H. S. Sypkens - - - - - - - - Hofloan C118, Middelharnis, Holland

European Orthodontic Society

President, E. Muzj - - - - - - - - - - - - - - - Via Parioli, 40 Rome, Italy
Hon. Secretary, Norman Gray - - - - - - 16, College Rd., Eastbourne, Sussex, England
Hon. Treasurer, S. E. Wallis - - - - - - 431, Footscray Rd., London, S.E. 9, England
Hon. Editor, G. E. M. Hallett - - - - - - - - - Kings College, Northumberland Rd.,
Newcastle-upon-Tyne 1, England

French Society of Dentofacial Orthopedics

President, J. Soleil - - - - - - - - - - - - - - 191, Rue Nationale, Lille, Nord
Vice-President, A. Leclercq - - - - - - - - - - - 9, Boul. de la Madeleine, Paris, 1[ER]
Secretary, G. Gugny - - - - - - - - - - - - - - - - 20, Rue Mogador, Paris, 4[E]
Treasurer, R. O'meyer - - - - - - - - - - - - - 93, Rue du Commerce, Paris, 15[E]

Guatemalan Association of Orthodontics and Relative Sciences

President, Eduardo García Salas - - - - - - 4a Calle Poniente No. 13, Guatemala City
Vice-President, Ricardo F. Novales - - - - Pasaje Rubio-Altos-Sur., Guatemala City
Treasurer, Salvador Santolino C. -
Secretary, Enrique Estrada H. - - - - - - - 8a Calle Poniente No. 8, Guatemala City
Assistant Secretary, Manuel H. Ortiz - - - - - - 5a Ave., Sur No. 52a, Guatemala City

Israel Orthodontic Society

Chairman, L. Block-Wolff - - - - - - - - - - - - - - - 22 Poalim St., Jerusalem
Secretary, G. Harth - - - - - - - - - - - - - - - - - - Pevsner St. 56, Haifa
Treasurer, J. Ben-Amar - - - - - - - - - - - - - - 6 Kernikowsky St., Tel-Aviv

Sociedad Peruana de Ortodoncia

President, Arturo Rojas M. - - - - - - - - - - - Av. Pershing 155, Orrantia, Lima
Vice-President, Augusto Taiman Villar - - - - - - - - - - Arzobispo 284, Lima
Secretary, Naldo Balarezo Gerstein - - - - - - - - - - - - - - Ica 138, Of. B.
Treasurer, Demetrio Calderón - - - - - - - - - - - - - - - - - Ortiz 369, Lima

Orthodontic Section of the Swedish Dental Society

President, Birger Kjellgren - - - - - - - - - - - Norrlandsgat. 31-33, Stockholm
Secretary, Irene Sundvall-Hagland - - - - - - - - - Folkungagatan 110, Stockholm
Allan Hellgren - Sveavägen 88, Stockholm
Anders Lundström - - - - - - - - - - - - - - - - - - - Stureplan 19, Stockholm

There is an apparent discrepancy

The pages are either missing or

The filming is recorded as the b

acy at this point.

r the pagination is incorrect.

book is found in the collections.

BACK COPIES WANTED

The Baylor Dental College urgently needs the following copies of the American Journal of Orthodontics to complete its original set:

Volume No. 1, 1915
2, 1916
3, 1917
4, 1918

The Librarian, Baylor Dental College, will be happy to accept these publications as a donation or will pay the publisher's current single copy price for each issue.

Please contact Mrs. Anna Geyer, Librarian, Baylor Dental College, 800 Hall Street, Dallas, Texas.

- The Margolis Cephalostat, the X-ray Fixator and the Camera Mount are now being constructed and distributed by the College of Engineering in conjunction with the Cleft Palate Institute of the School of Dental Medicine of Tufts University.
- Information may be obtained by addressing inquiries to: Professor E. Leavitt, Department of Mechanical Engineering, Tufts University, Medford 55, Massachusetts.
- It should be emphasized that the construction and distribution of this equipment is strictly on a non-profit level on the part of Tufts University and those individuals associated with the University.

INDEX TO ADVERTISERS

Please mention "American Journal of Orthodontics" when writing to our advertisers—it identifies you

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

AMERICAN JOURNAL OF ORTHODONTICS

Published by THE C. V. MOSBY COMPANY, 3207 Washington Blvd.
St. Louis 3, U. S. A.

Entered at the Post Office at St. Louis, Mo., as Second-Class Matter

Published Monthly. Subscriptions may begin at any time.

Official Publication of The American Association of Orthodontists, its component societies and The American Board of Orthodontics

EDITORIAL COMMUNICATIONS

Original Communications.—Manuscripts for publication and correspondence relating to them should be sent to Dr. H. C. Pollock, 8015 Maryland Ave., St. Louis 5, Mo., U. S. A.

Manuscripts should be typewritten on one side of the paper only, with double spacing and liberal margins. References should be placed at the end of the article and should include, in the order given, name of author, title, journal, volume, pages, and year; e.g., Smith, E. J.: Children's Dentistry, Am. J. Orthodontics 34: 1-25, 1947. Illustrations accompanying manuscripts should be numbered, provided with suitable legends, and marked lightly on back with author's name. Articles accepted for publication are subject to editorial revision. Neither the editors nor the publishers accepts responsibility for the views and statements of authors as published in their "Original Articles."

Illustrations.—A reasonable number of halftone illustrations will be reproduced free of cost to the author, but special arrangements must be made with the editor for color plates, elaborate tables or extra illustrations. Copy for zinc cuts (such as pen drawings and charts) should be drawn and lettered only in India ink, or black typewriter ribbon (when the typewriter is used). Only good glossy photographic prints should be supplied for halftone work; original drawings, not photographs of them, should accompany the manuscript.

Books for Review.—Only such books as are considered of interest and value to subscribers will be reviewed, and no published acknowledgment of books received will be made. These should be sent to Dr. J. A. Salzmann, 654 Madison Ave., New York City.

Reprints.—Reprints of articles must be ordered directly through the publishers, The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo., U. S. A., who will send their schedule of prices. Individual reprints of an article must be obtained through the author.

BUSINESS COMMUNICATIONS

Business Communications.—All communications in regard to advertising, subscriptions, change of address, etc., should be addressed to the publishers, The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Mo.

Subscription Rates.—United States and its Possessions $10.00, Students $5.00; Canada, Latin-America, and Spain $10.50, Students $5.50; Other Countries $11.00, Students $6.00. Single copies, $1.75 postpaid. Remittances for subscriptions should be made by check, draft, post office or express money order, payable to this Journal.

Publication Order.—The monthly issues of this Journal form one volume a year; the index is in the December issue.

Change of Address Notice.—Six weeks' notice is required to effect a change of address. Kindly give the exact name under which a subscription is entered, and the full form of both old and new addresses, including the post office zone number.

Advertisements.—Only articles of known scientific value will be given space. Forms close first of month preceding date of issue. Advertising rates and page sizes on application.

Bound Volumes.—Publishers' Authorized Bindery Service, 308 West Randolph Street, Chicago 6, Illinois, will quote prices for binding complete volumes in permanent buckram.